PLANNING FOR CITY TRAFFIC

The Annals

VOLUME CXXXIII — SEPTEMBER, 1927

Editor in Charge of this Volume:
AUSTIN F. MACDONALD

THE AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE
3622–23 LOCUST STREET
PHILADELPHIA
1927

EUROPEAN AGENTS

ENGLAND: P. S. King & Son, Ltd., 2 Great Smith Street, Westminster, London, S. W.
FRANCE: L. Larose, Rue Soufflot, 22, Paris.
GERMANY: Mayer & Müller, 2 Prinz Louis Ferdinandstrasse, Berlin, N. W.
ITALY: Giornale Degli Economisti, via Monte Savello, Palazzo Orsini, Rome.
SPAIN: E. Dossat, 9 Plaza de Santa Ana, Madrid.

CONTENTS

FOREWORD

A SPEAKER recently applied Mark Twain's time-honored phrase concerning the weather—that everyone was talking about it, but no one ever seemed to do anything about it—to traffic congestion. There can be no doubt that people are talking about the traffic problem. Overcrowded thoroughfares and traffic delays are central themes of conversation, for they affect vitally the life and habits of every city dweller. It is not fair to imply, however, that nothing is being done to remedy the situation. On the contrary, some of the nation's best minds have devoted years of time and thought to the matter of traffic congestion. Yet every year the problem is becoming increasingly acute. The strain upon our existing transportation facilities is becoming constantly greater. Nearly twenty-two and a half millions of automobiles were registered in the United States during 1926. The registration of the previous year barely reached the twenty million mark. A decade earlier it was less than six millions. Traffic congestion in the downtown section of many a metropolis is fast becoming traffic saturation.

City traffic is an expensive proposition. It costs many dollars—how many, no one knows—in wasted time, in widened streets. It is beginning to cost small fortunes in double-deck thoroughfares, such as Chicago's famous Wacker Drive, and in arcaded sidewalks. Every year it takes a heavy toll of human life. During 1926 half a million people were injured in automobile accidents, and twenty thousand or more were killed. Such a problem merits serious consideration.

This volume is dedicated to the city dwellers of America—to the men and women whose lives are daily affected by traffic congestion. It is written by a group of traffic experts—men whose daily task is to devise ways and means of relieving the congestion. Because the contributors are technicians, it is hoped that their proposals will prove of value to students of the question. Because their language is non-technical, it is hoped that their suggestions will be of interest to everyone. Planning for city traffic may not be the most serious of our municipal problems, but certainly it is receiving the most widespread attention.

AUSTIN F. MACDONALD.

Coördination of Traffic Facilities

By John Ihlder

Manager, Civic Development Department, Chamber of Commerce of the United States

OUR problem belongs to that well-known variety, easy to solve by descriptive generalization, difficult in specific application. Assuming that with the approaching arrival of the airplane we shall have before us all the means of locomotion, we need merely assign to each its proper function in community movement. First we may divide these means into two groups: long distance and local. Then we may divide them again into those using private rights-of-way and those using public rights-of-way. Then we may divide them once more into slow moving—usually heavy vehicles—and fast moving—usually light vehicles. Then we may make a last division into passenger and freight. Having these four sets of twos our task is to fit them to each other and then to provide facilities so they may function effectively and with the least friction or interference.

What Type of Community?

Obviously an essential in the solution of the problem is agreement upon the type of community our traffic facilities are to serve. Here we at once encounter some difficulty. Not only are the majority of men rather hazy on this subject, but there are two distinct schools of thought.

One school maintains that Manhattan Island with its skyscrapers and great apartment houses, imperfect though it is, represents the line of advance. Cloud-piercing tower buildings whose populations, theoretically, are each self-sufficient and whose traffic needs, during business hours, are largely met by batteries of elevators point the way in which the city of the future should be built. Intensive concentration to the limit of human ingenuity, subway below subway to care for morning and evening peak loads, elevated sidewalks to keep pedestrians—on the, theoretically, rare occasions when they must go from building to building—from under the wheels of trucks and taxicabs, this, it says, makes for efficiency.

The other school would have a widespread city. It has no satisfactory American example to which to point, and when it utilizes foreign ones its opponents at once make assertions that, lacking the necessary data, it cannot effectively confute. But it has an abiding faith that in broad America there is space enough to build widespread cities without depriving the farmers of essential crop land, and that, properly planned, these cities will prove more efficient and certainly more economical to operate than the concentrated cities. Its most telling illustrations are of things that should *not* be done *again*—the subways, for example, on which New York spends so much of its resources to no perceptible end. For one subway apparently leads only to another. But it has some indications of what it believes will make for a better city, as the major highway system to which Providence, R. I., has recently committed itself.

Between the two extremes, represented by the skyscraper district of Manhattan, and the five- or six-story height limit of a European city, lies the possible, perhaps the probable future American city. The tall office

buildings have their advantages, provided there are not too many tall office buildings and they are not crowded too closely together. Zoning may take care of that. Even the large apartment houses have their advantages, provided there are not too many of them and they have adequate yards and courts. Zoning and housing regulations may take care of that. But such concentrated areas also have their serious disadvantages and as a result American cities, utilizing modern traffic facilities, have been spreading out. So our attempts at coördination will have to take account both of building up and of building out.

THE PROBABLE AMERICAN CITY

Assuming, then, that the American city will contain at least one concentrated business district with high office buildings, that it will contain districts for apartment houses, but that by far the greater part of its area will be devoted to less intensive building—what traffic facilities will be required and how shall they be coördinated?

This assumption is based on present fact and assurance that present fact will continue during that section of the future which concerns us here. It would, however, be futile to prophesy with any attempt at precision how high we shall raise the office buildings erected five, ten, twenty years from now, how large will be the area allocated to skyscrapers, where we shall permit construction of apartment houses. This whole matter recently has entered a new phase due to questioning of the economic value of high buildings. Even advocates admit that in the largest cities an office building becomes, according to the often quoted phrase, "a monument, an advertisement, or a failure" if it exceeds twenty stories. Those not so warm in advocacy reduce this height to fourteen, ten or even fewer stories, and as evidence point to the work of one hard-headed New York builder who, within the past year or so, has erected on some of Fifth Avenue's most valuable frontage two office buildings only five and six stories high.

NOT HEIGHT, BUT CUBAGE

But already the controversy is shifting from height to cubage. Traffic capacity of streets and light and air for adjoining buildings are being recognized as basic considerations. At the same time more analytical studies of rental values are apparently showing that not only is store frontage on the street level the most valuable part of a business building, but that the office floors immediately above those used for retail trade are the least valuable. So it may be that, now the tower building has been proven practicable, we shall evolve a skyscraper whose height on the sidewalk or building line will be governed by its availability for retail commerce—ranging from two to four or five stories—above which there will be a generous setback perhaps even a tower rising from an interior court, to a height proportioned to the area of low building and open space around it. This will give the offices all the advantages they now enjoy plus some protection from the noises and dust of the streets, plus protection against the danger of being blanketed by a skyscraper on the adjoining lot line. And, by reducing the cubage, which means reducing the number of inhabitants per acre, it will simplify the community's traffic problem.

As for apartment houses, recent decisions by the highest courts of some of our most conservative states as well as by the Supreme Court of the United States give assurance that they can now be confined to definitely allocated districts. Here again the problem is

largely an economic one. Multi-family dwellings seem to thrive in locations where one-family dwellings deteriorate into dilapidated rooming houses. To be sure, they also seem to thrive in the midst of one-family dwellings, sponging on their neighbors for light and air and a more attractive environment. Their profit in such locations, however, is apt to be the community's loss, for their presence destroys small house values. So the community, in order to protect itself against the liability of blighted areas, will confine them to their allotted district. This has its bearing upon provision of traffic facilities as it has upon provision of other public services, such as sewer, water, telephone, for the denser apartment house population requires more street space, and more conveyances within a given area than does the more widely distributed one-family-house population. Recognizing this, it may be that multi-family-house districts will follow main lines of transportation, so affording a profitable use for property that today, with the development of great arterial highways through residential areas, has become of problematical utility.

CAN VOLUME OF TRAFFIC BE REDUCED?

In most of our traffic discussions there is an easy assumption that what we now have we shall continue to have, only in increasing degree. The estimates of loss due to traffic delays, which reach figures reminding us of war-time financing, usually are based upon this assumption and therefore lead inevitably to expensive proposals for new streets cut through the centers of blocks, for double-decking or widening of streets. A careful study of New York's traffic, published about a year ago, described the increase of that traffic for which present facilities are so inadequate, proposed street widening and double-decking, and yet indicated clearly that if its recommendations were followed the new facilities could not be provided before they too would be inadequate. So common has this assumption become that some students have worked out a mathematical formula which indicates just how much more rapidly traffic increases than does population.

This assumption is ripe for challenge. It is quite possible that we have today a vast amount of unnecessary and therefore wasteful traffic. The number of vehicles on the streets at any given time is in proportion not only to the volume of business to be done, but to the distance each vehicle has to traverse. Cutting that distance in half may afford as much relief to traffic as double-decking streets, and may be much less expensive. City planning and zoning should afford this relief by bringing closer together points of traffic origin and destination. Much of the routine travel in our large cities today is due to their conglomerate character which compels travelers to spend time and vitality in passing hundreds of buildings with which they have no concern, but which intervene between points of departure and destination. Segregation of industries should result in bringing home and work closer together so that a much larger proportion of the population could go from one to the other on foot instead of by suspending themselves from straps.

A REGIONAL PLANNING TASK

Such reduction of unnecessary traffic is essentially a task for regional planning and zoning which will provide for more homogeneous, more nearly self-sufficing communities of moderate size, each accessible to the others and to the central community of the region by express routes. The boundaries of

these communities may be, where opportunity still exists, parkways or parks or even farming land, or they may be the wide traffic arteries already planned, in a few cases already created. Within these boundaries each community or neighborhood will live much of its life undisturbed by traffic and traffic problems.

The realization of these regional plans will aid in the division of traffic facilities into long distance and local by so reducing the local that attention can be concentrated on the needs of express service from one important center to another. It also will go far in enabling us to provide adequately for a segregation of the miscellany of traffic that today as much as its volume congests our roadways. Street cars, trucks, passenger automobiles, long distance and short distance, all using the same traffic lane, present one of the most striking instances of inefficiency to be found in America. An inherited street system designed for horse-drawn vehicles but called upon to carry all the wheeled products of an inventive age, has passed the limits of its effective capacity. The arterial-boundary thoroughfares, both radial and circumferential, wide enough to accommodate the various kinds of traffic, each in its own lane, will not only expedite movement but will relieve other streets, which can then revert to their proper function of serving local needs.

GREATER USE OF FREE WHEEL VEHICLES

Out of the confusion of the counsel we are receiving one point seems clear, that we shall use increasingly the free wheel vehicles at our disposal. This does not mean the disappearance of rail and water carriage any more than it means the disappearance of the earliest form of transit, our own feet. Just as walking has begun to assume a new importance in New York, where multiplicity of mechanical aids to locomotion compels the natives to cover constantly greater distances on foot in getting from one to the other, so increase of free wheel traffic may be expected to give a new importance to rail and water carriers, whose supremacy in long distance movement seems seriously threatened only by the airplane, and by the airplane only in a restricted part of their business. Apparently all our vehicles are on the way to filling mutually supplementary rôles which will give to each other duties it can best perform.

This will require provision not only of adequate rights-of-way—in which the airplane must definitely be included if it is not to become a nuisance and a hazard—but, what has been even more neglected, adequate terminal or parking facilities. Wharves for vessels and stations for railroads are commonplace enough to be accepted without question. But terminal or parking facilities for our free wheel vehicles are still in the stage of instructive resistance. Precedents are not clear. Railroads, with private rights-of-way, have naturally provided themselves with privately owned and operated freight and passenger stations. Shipping lines, utilizing government dredged and lighted channels, have not as consistent a terminal history. Those wealthy enough usually own and operate their wharves, but communities have sometimes believed it in the public interest to provide public wharves available to all comers. In the cases both of rail and water carriers, these transfer places often have been located without much regard for the street system.

With the increasing coördination of traffic vehicles, with railroads operating fleets of trucks and street railway companies securing control of bus lines and taxicabs, the necessity for a better

coördination of facilities is becoming more evident. When fifty trucks of fifty different merchants stand idly at a freight station awaiting opportunity to load or unload, or are held up by street traffic congestion on their way to the station, not only is the loss so widely distributed as to seem unimpressive, but no one of the fifty has power to improve the situation. When, however, the fifty trucks belong to one corporation and that corporation perhaps one which can change conditions, the waste does become impressive. So stations are being moved out from the congested centers of cities, and coincidentally thoroughfare plans are taking cognizance of station location.

THE STANDING CAR

More difficult is the problem of station or parking space for vehicles which have no private rights-of-way. Using the public streets for movement, carrying over habits formed when our streets were abundantly able to meet the traffic demands upon them, we have acquiesced in use of public streets for parking passenger vehicles—including trolley cars, loading and unloading merchandise, until moving traffic is seriously interfered with. Then, in accordance with normal, human reaction to discomfort, we emotionally demand the abolition of all street parking, at least down-town. Fortunately the private automobile has already so firmly established itself, has so many owners and therefore advocates, that this emotional demand prevails only where, because of the combination of large buildings and narrow streets, the situation has become intolerable. Otherwhere it has forced us to undertake the hard task of constructive thinking.

This thinking is leading to some tentative conclusions: while streets are primarily for moving traffic, terminal or parking facilities at or near destination must be provided, else there is no purpose in moving. Where streets are wide enough for both movement and parking, both should therefore be permitted. Where streets are not wide enough, either because their designers lacked vision or because we of the present generation have permitted construction of buildings out of proportion to the street's traffic capacity, either those streets will lose value through the removal of business to more adequate thoroughfares or we must provide additional facilities. First the trucks receiving and delivering merchandise must be provided for elsewhere, perhaps in rear alleys and courts, preferably on private property. Some recent New York business buildings now contain truck-loading spaces even though this means the sacrifice of valuable store frontage. Second, the all-day parking of tenants' passenger cars, prohibited by police regulation, is being provided for by storage space in office buildings or by day storage garages.

THE DAY STORAGE BUSINESS

Day storage is a new business and, as usual, we are learning through experience to correct some initial theories. One of the lessons we seem to be learning is that day storage garages must be on main traffic arteries, *i.e.*, on valuable land. For apparently drivers will not go two or three blocks out of their way to seek a garage on a back street. Another is that the profit of such garages is to be found, not in the day storage charge, which must be kept moderate if patrons are to be attracted, but in service charges. Attention having been called to this, it seems quite obvious. The great majority of self-drivers keep their cars at night at home or in a neighborhood garage where service must be paid for at night

rates or the car not used when most wanted. Another lesson is a sequel of the second, that the potential customers of day storage garages are all-day parkers, regular patrons, not the casuals who come down-town occasionally to shop or to call on the dentist. If they cannot find free harborage at the curb in front of their destination, they incline to go elsewhere—and business inclines to accommodate them. Even the dressmakers and jewelers of Paris are leaving the streets, so long associated with their trades, to compete with automobile showrooms for space on the Champs Élysées, where automobile patrons can park while shopping.

The presence of the private automobile is undoubtedly the most difficult feature of our traffic problem. Consequently some would-be solvers propose to cut the Gordian knot by prohibiting it wherever it causes embarrassment. Tradition says that the first user of this method got away with his solution, but his imitators are not likely to fare so well. The indications are that the ultimate result would be a change in the use of property fronting on prohibited streets. Traffic counts in Chicago and other cities indicating that, after all, automobile patrons form only a small part of the down-town stores' clientele, are not convincing, for experience shows that increase of facilities immediately brings increase of automobile patronage and that restriction of facilities builds up new business districts. The private passenger car has two virtues that give it power to mold our cities; it takes its driver where he wishes, when he wishes without long walks at either end—provided there is parking space, and without waiting for the train to come; it itself occupies space which otherwise would be uncomfortably filled with human beings. In other words, it provides the means for distributing population and it forces distribution.

CONCLUSION

With all the modern means of traffic we are today again building round cities in contradistinction to the star-shaped cities we built when our dependence was upon radiating lines of rails. In this we are utilizing water and rail transport for the longer distances, in this we shall utilize the airplane for still longer distances. And for these we are providing stations where transfers are made to local means of transportation. These stations will become more and more the local points of our local traffic facilities. From them arterial highways will lead to other local centers, incidentally serving as the boundaries of areas or communities in large degree self-sufficing. The principal arterial highways will have width sufficient for segregation of traffic into rail and free wheel, fast moving and slow moving, through and local; or different streets will be assigned, one primarily for rail cars, one primarily for heavy vehicles, one exclusively for light and fast moving vehicles. As in zoning for use, stores and residences may be permitted in a district zoned for industry—there is little danger that they will abuse the privilege, residences may be permitted in a commercial district, but industries and stores must be forbidden in a residential district, so trucks and passenger cars are unlikely to use a narrow street-car street unless they have business there, passenger cars are unlikely to use a trucking street unless they have local points of call, but the light traffic street appears to attract other vehicles and consequently it must be protected from them —on condition that adequate facilities are provided for the others.

In this no attempt is made to forecast the issue between street car and

bus. Both are with us and both seem destined to remain for years to come, meanwhile settling their differences through common ownership which probably will extend—following Philadelphia's example—to include the taxicab. The rail car may maintain its position as the agent for mass movement, the bus be developed as its feeder, but the prospects are, so far as provision of facilities is concerned, that one will be either an extension of the other or to some extent its supplanter, especially in the less densely populated areas lying between arterial highways. From the community point of view they are much the same, heavy vehicles which follow regular routes, affect injuriously certain types of property when it is immediately adjacent to those routes, hinder other traffic not only by their bulk but by their frequent stopping to take on or discharge passengers. The taxicab, whose future will be linked with that of the trolley car or bus, seems destined to be both a feeder for its associates at outlying centers and a supplanter in some degree, especially down-town, of the privately owned passenger car. Already family budgets are being revised with taxi fares substituted for interest, depreciation and operating costs. As day storage charges become more common, such revisions will follow suit. But the taxicab suffers under the handicap of sometimes being unavailable when most wanted, as during a heavy rain-storm or a championship football game.

In this, again, no attempt is made to link up the subway. It is, like the outside iron fire escape, now happily tending to disappear, a confession of failure to build properly. Admitting, for the sake of the argument, that it was necessary in New York and Boston, because our immediately preceding generation gave no thought to a relationship between the bulk and use of buildings and the traffic capacity of streets, experience has shown that subways, unaccompanied by regulation of bulk and use of buildings, result in worse conditions, not better. Having learned that the key lies in the relationship between buildings and street capacity, it is at least as easy and far less expensive, to establish that relationship at a time when traffic can be carried on the surface. New York's traffic problem below 59th Street and between the rivers contains elements so peculiar to itself that it may be left for solution to the geniuses who created it.

The Traffic Survey

By Miller McClintock, Ph.D.
Director of the Albert Russel Erskine Bureau for Street Traffic Research in Harvard University

A TRAFFIC survey, as the expression is used in this paper, is merely an indication of the more serious attention which the major American cities are giving to their immediate problems of street traffic congestion and accidents. A survey of traffic is an attempt to substitute accurate facts of an engineering character for guesswork in the formulation of plans for the reduction of street friction and conflicts. In the more limited sense, as here used, it is designed primarily for the purpose of affording knowledge which will serve as a rational basis for the erection of a traffic control system making possible a safer and more convenient use of existing facilities. In this it differs materially from city planning studies which have as their end the construction of a more ample street system. Many of the materials collected in a well-designed traffic survey, however, will be of value for planning as well as control improvements.

The growing pressure of the street traffic problem as manifested in increased inconvenience and hazard to the general public, and in economic losses to commercial interests, has rendered it imperative that this aspect of urban life be given the same formal attention that has been given to other major municipal problems of a physical character. In the larger cities the complexities of the traffic problem have long since passed the point where they can be adequately treated by casual methods. Legislative bodies and police departments are no longer so effective in their unaided attempts to bring relief. It is more and more to the engineering profession that cities are finding it necessary to turn for assistance and guidance. This is only a natural development, for essentially the problem of moving great masses of persons and commodities over the streets is of an engineering character.

The Development of a Traffic Control Technique

City planning engineering has long been recognized as an important and standard phase of municipal administration. The application of engineering skill to the problems of traffic control is of much more recent origin, having a history of not more than five years. Thus far much of the work has been, of necessity, more or less tentative and experimental. Yet in practically all instances the results which have been obtained have been of such a superior character as to justify the undertaking and to warrant its continuation. Among the larger cities the following at the present time have official or quasi-official engineering agencies dealing primarily with traffic control problems: Los Angeles, Chicago, Boston, San Francisco, Washington, Buffalo, Detroit, Pittsburgh, and St. Louis. The progress already achieved in these cities and the general interest in the movement would indicate that within the near future such agencies will be a regular part of the administrative machinery in all cities.

Thus far the technique for traffic control has been drawn largely from allied fields of engineering, and public

administration. City planning work, especially that aspect which deals with street layout and design, has contributed substantially. Transportation engineering as applied to urban traction operation has been of material influence, because of the similarity of the operating difficulties confronting street car traffic and vehicular traffic. Electrical engineering has supplied much valuable assistance through the development of traffic control devices, and more especially through the design of methods for the operation of these devices.

A hopeful indication that there will be a supply of trained personnel is to be found in the interest which a number of American universities have taken in the problem. Harvard University, Yale University, the University of Pittsburgh, the University of Michigan, and the University of California are among those that have given more or less formal encouragement to a professional interest in traffic control methods. In the University of Michigan instruction is given in methods of regulation in connection with the courses in highway engineering. In Harvard University, through the endowment of the Erskine Bureau by the Studebaker Corporation of America, fellowships are provided for graduate students and machinery is established for the collection and dissemination of original information regarding traffic control methods in various American cities.

ORGANIZATION OF A TRAFFIC SURVEY

A traffic survey is a study which should be conducted constantly to keep public officials informed as to the necessity for traffic regulations. Surveys in typical cities have generally preceded the establishment of regular engineering agencies, and have, therefore, served as a general inventory of traffic conditions and requirements, resulting often in the organization of a permanent engineering staff to carry on the fact finding operations.

Since the pressure of traffic is generally felt more acutely by business men than by public officials, due to their direct losses, it is not surprising that the initiation and financing of traffic studies should frequently come from private interests. This has been the situation with the surveys conducted in Los Angeles, Chicago, and San Francisco. In the first city the initial movement took the form of the organization of the Los Angeles Traffic Commission. Some brief description of this body is pertinent as it has served to a degree as a model for similar organizations elsewhere. After four years of existence it still remains as a quasi-official group, composed of and financed by representatives of the principal traffic interests of the city. These include among others, the traction companies, the motor car dealers, the automobile club, retail merchants, and public utilities. A budget of approximately $60,000 per year provides for administrative and technical services. The original survey of traffic was conducted more than three years ago, and since that time the staff has continued its studies which serve as the basis for recommendations for refinements in traffic control methods. The significant elements in the Los Angeles organization, which may well be considered by other cities contemplating similar activities, are to be found on one hand in a group of laymen sufficiently representative of the city interests to speak with authority, and on the other hand a technical staff for the collection and analysis of necessary data.

The San Francisco survey has been conducted under an organization al-

most identical in form to the Los Angeles Commission with the exception that it has a more official complexion, its members being appointed by the mayor. The survey of Chicago was financed by the Chicago Association of Commerce at the request of the Board of Aldermen, and under the general supervision of a committee of seventy representative laymen and public officials.

The traffic survey of Boston differs from those described above in that it was initiated by the city administration and has been financed entirely from the public treasury. The important elements of the other organizations are retained, however, for the technical staff reports to an advisory group of twenty-five representative citizens appointed by the mayor.

Other cities such as Washington, Buffalo, Detroit, Pittsburgh, and St. Louis have undertaken their traffic surveys directly as a part of the activities of a traffic engineering division of the public administration, with varying degrees of dependence upon lay advisory groups.

THE FIELD OF INVESTIGATION

Being designed primarily to render available information for the creation of a complete system of traffic control for the city, the survey must cover all problems which affect the safe and orderly movement of traffic. No two cities are identical. Each has its peculiar physical problems, as each has its individual community habits. Much difficulty has been caused by the attempt to transplant successful control methods from one city to another, where conditions may be radically different. It is impossible to indicate in detail the precise routine of investigations which should be followed in any community. There are certain general subjects, however, which warrant consideration in all cities.

As a preliminary to the design of a survey it is requisite that there should be a full understanding of the layout and capacity of the street plan with special consideration to those streets which are obviously main arteries of travel. Attention should also be given to obstructions in the street plan which cause a choking or diversion of traffic flow. Naturally such preliminary consideration will include a study of the layout and operating conditions of the local street car system.

TRAFFIC VOLUME AND CHARACTER

A knowledge of the relative volume and direction of traffic in various portions of the city being imperative for a full understanding of traffic conditions, the collection of data for the making of a traffic flow map is one of the first steps that should be undertaken. For the purpose of subsequent regulatory recommendations the checks of traffic volume should be made at the more important intersections along those arteries of travel which preliminary observation has indicated to be of primary importance. Such intersection studies of volume will make possible not only the drafting of a general flow map, but will also reveal the relative importance and needs of traffic control at various intersections throughout the city. The information is of special importance in the larger cities where extensive programs of traffic signal installation are contemplated. Figure 1 illustrates a traffic flow map of the city of San Francisco. Among other matters will be noted the restrictive effects which the topography of the city has upon traffic movements.

Observations of typical speeds of traffic from the center of the city out-

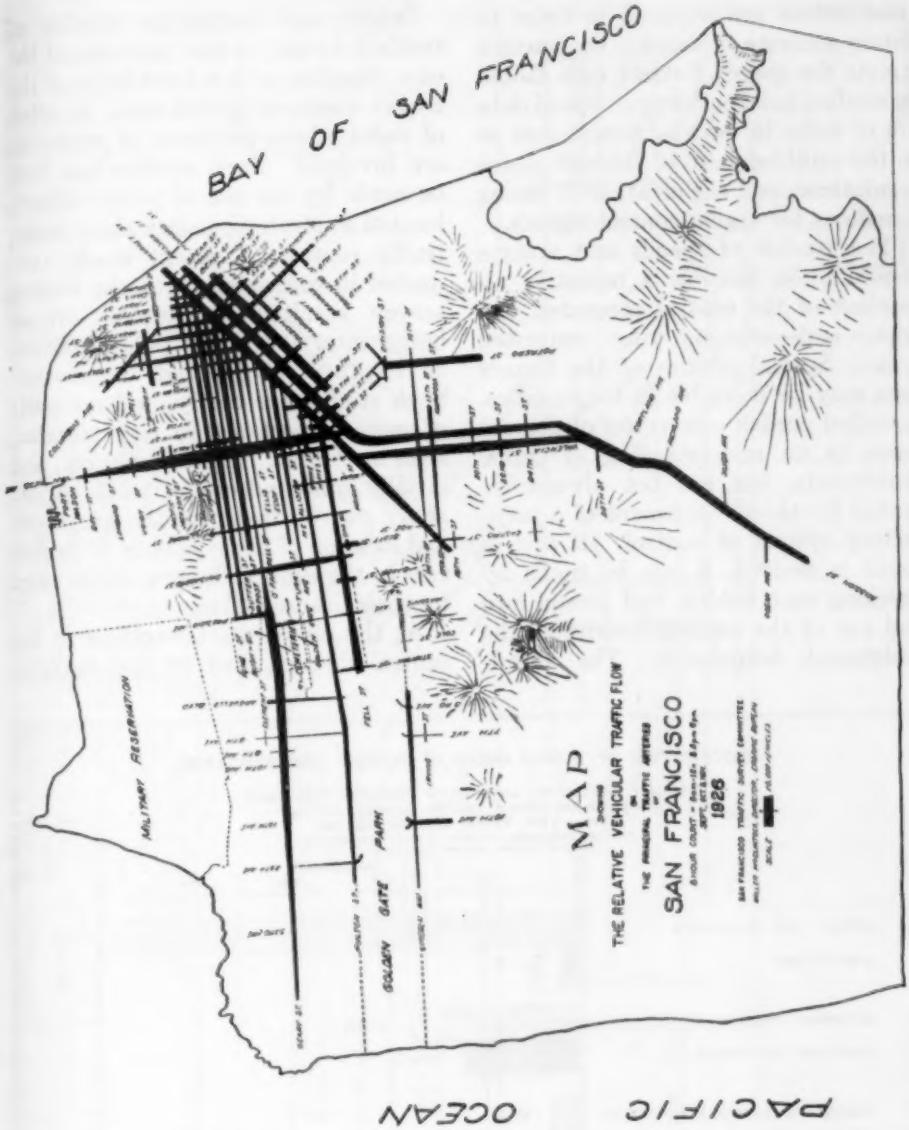

BAY OF SAN FRANCISCO
MAP
SHOWING
THE RELATIVE VEHICULAR TRAFFIC FLOW
ON
THE PRINCIPAL TRAFFIC ARTERIES
OF
SAN FRANCISCO
8 HOUR COUNT - 9 AM TO 5 PM
SEPT. 27 TO OCT.
1926
SAN FRANCISCO TRAFFIC SURVEY COMMITTEE
MILLER MCCLINTOCK, DIRECTOR, TRAFFIC SURVEY
SCALE
MILITARY RESERVATION
GOLDEN GATE PARK
PACIFIC OCEAN

FIGURE 1

wards along the principal arteries should be made with a recording of the rates maintained between various points along the route. Numerous speed observations are required in order to obtain accurate averages. On traction streets the speed of street cars should be studied independently. Speed data are of value in drawing conclusions as to the establishment of through street regulations, and the creation of timing schedules for traffic control signals.

The studies of speeds and volume should make possible a tentative allocation of the central congested district, and any outlying congested areas. Special studies of the former area may be desirable in larger cities. So-called cordon counts are of general value in an understanding of traffic movements, but are not always essential for the development of a satisfactory system of control. If such a count is desired, it can be made by checking each vehicle and person into and out of the central district at the designated boundaries. The distribution of persons among different types of traffic units resulting from such a cordon count is indicated in Figure 2.

Origin and destination studies of traffic between various portions of the city, together with a knowledge of the routes customarily followed, is often of value where problems of rerouting are involved. Such studies can best be made by the use of police officers, located at strategic points along major traffic routes. A recent study conducted in connection with the Boston survey resulted in 100,000 drivers being interviewed by police officers, as to their origin and destination. Such studies are costly, and normally of more importance in city planning than in control. A much simpler, and usually quite adequate, traffic origin study can be made by the geographical location of the residence of parked cars in the central district, as revealed by their license plates.

At the crowded intersections in the central district, and at the outlying

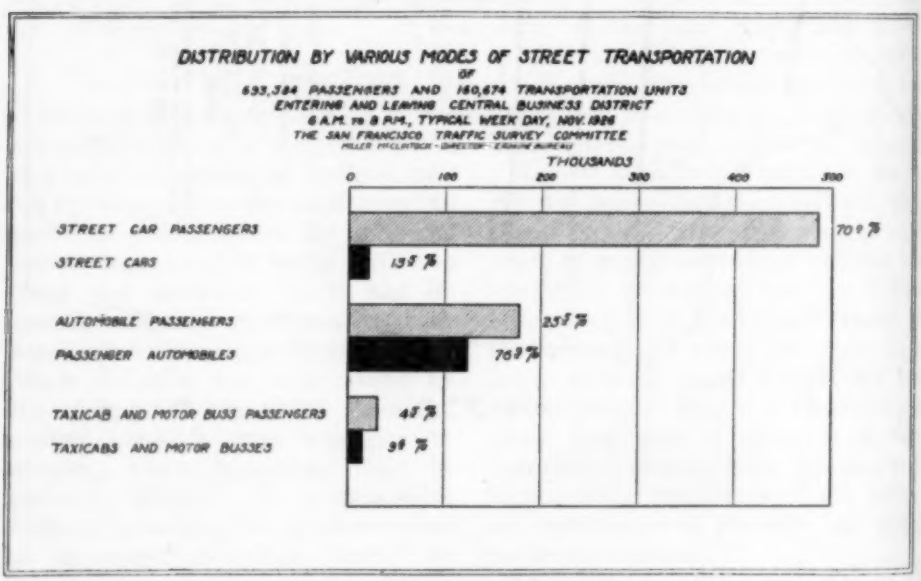


FIGURE 2

RECOMMENDED TRAFFIC CONTROL AND VEHICULAR TRAFFIC FLOW AT FOURTH & MARKET STS.
Fig. 4
TYPICAL WEEK DAY (Ave) Nov. 1926
Total Flow Through Intersection — 17,532
The San Francisco Traffic Survey Committee
Miller McClintock, Director, Eugene Reeves
TIMING OF SIGNALS
Signal Number
Rate
Timing for 60 Sec. Cycle
Go
Caution
Stop
1,3
2,4,5
4&7&8,11
6
7
10
5,9
12
Time refers to Seconds after any even minute
NOTE: Do not allow left turns from Ellis St to Stockton St
LEGEND
Traffic Signals
Special Pedestrian Signal
Crosswalk
Safety Zone or Station
Curb Line
N
STOCKTON ST.
ELLIS ST.
MARKET
STREET
FOURTH ST.

FIGURE 3

intersections that have been indicated as important by the volume studies, it is desirable that there should be a detailed study of the character and direction of traffic as well as of volume. This study should include types of vehicles, number and character of turning movements, and the volume and direction of pedestrian traffic. Figure 3 indicates the result of a traffic directional flow with certain recommendations for control based on the data presented.

PARKING STUDIES

The regulation of parking is one of the most difficult elements in traffic control, largely because of a lack of specific information regarding the relation of curb storage to traffic movement, and business operations. Naturally the chief requirement for study is to be found in the central business district, which in most cases will correspond in general to the principal retail area.

The total curb footage of this district (with subtractions for legal restriction) divided by the space occupied by the typical parked car will give the total parking capacity in car units. The manner in which the capacity is utilized is of importance in the fixing of time limits and prohibitions. The length of time parked by the average car, the classes of cars parked, and the character of violations in manner of parking should be obtained. For this study the form contained in Figure 4 has been found useful, as it simplifies computations after the materials have been recorded. By an analysis of parking loads in various portions of the central district, it is possible to discover the centers of greatest demand, thus affording valuable information to those who may contemplate the construction of storage garages.

The relation between retail business and curb parking forms an important factor in parking regulations. A considerable amount of parking interference with traffic movement is tolerable if such parking contributes materially to the convenience of business. If, on the other hand, it is found that curb parking contributes a negligible amount of service to business concerns one of the chief objections to its restriction disappears. The importance of this service together with other valuable information of a general character can be obtained by means of an investigation that may be termed a modes of transportation study. Such a study can best be conducted by in-

Registration No.		Automobile	
		Taxicab	
		Truck	
		Horsedrawn	
		Bus	

Block	Side	Time	
In Red Zone			
In Yellow Zone			
In front of driveway			
Improper angle			
Too far from curb			
Double line parking			

Street	Town

FIGURE 4

terviewing the patrons of the principal business establishments. Such studies indicate that the central districts of different cities vary materially in respect to the number of patrons that are able to use curb parking. Thus for example the loop district in Chicago shows only 1.5 per cent of retail patrons coming from curb-parked cars, while in San Francisco the amount is in excess of 8 per cent. It is obvious that in the former city an entire prohibition of parking would cause much less disturbance to established shopping habits than in the latter.

PEDESTRIAN MOVEMENTS

Regulatory methods for the control and protection of pedestrian traffic has become an important part of any consideration for general traffic improvement in the larger cities. Sidewalks as well as roadways have become congested in many places, making it necessary to take steps to clear the walks of unnecessary obstructions, and in some cases to control pedestrian movements.

The study of sidewalk traffic is important not only from the standpoint of control but likewise because of the effect which pedestrian volume has upon business location. A full understanding of this question requires a check of the volume of sidewalk traffic at the more important places in the central district. In connection with this study it is often desirable to conduct a study of the door traffic into and out of the more important buildings, with special reference to the peak loads, which occur in the morning, at noon, and in the afternoon. There is a definite correlation between the density of sidewalk traffic and the speed with which such traffic moves. An observation of this relationship is illustrated in Figure 5.

The movement of pedestrians in the

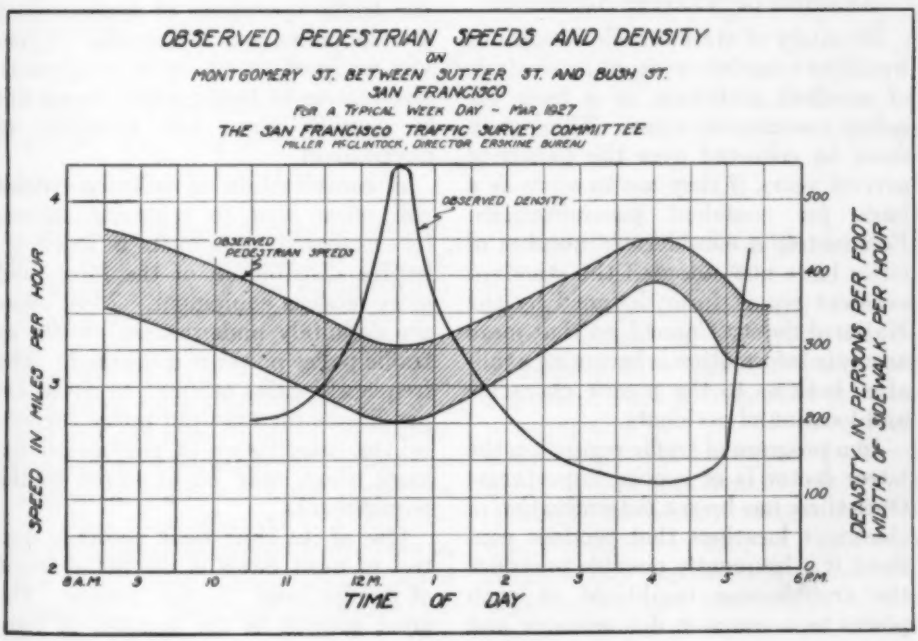


FIGURE 5

roadways also warrants consideration, as it is here that the great majority of the personal injury accidents, both fatal and non-fatal, take place. A check of the volume of mid-block crossing, or jay-walking, often reveals interesting conditions. In case pedestrian control is contemplated, a detailed analysis of the volume and character of pedestrian movements at intersections becomes imperative. A recent study of this kind conducted in connection with the Chicago survey revealed the fact that one sidewalk at an important intersection carried two thousand persons per foot of width, per hour, during the heaviest traffic periods, and that during the peak hour a total of 49,250 persons crossed the intersection. A five-hour count showed 192,930 walkers entering this street corner. The collection of such information and its careful analysis is essential to the success of any program of pedestrian regulation.

ANALYSIS OF TRAFFIC ACCIDENTS

No study of street traffic conditions would be complete without an analysis of accident statistics, as a basis for safety recommendations. These data must be collected over the period of several years, if they are to serve as a basis for confident generalizations. Fortunately a considerable number of cities have now adopted the standard accident report form designed by the National Safety Council, so that more accurate information is becoming available, both as to the precise character and location of accidents.

In a program of traffic regulation the latter factor is of special importance. Once there has been a determination of the exact locations that produce conflicts, it is frequently possible to reduce the troublesome conditions at such places to a common denominator and prescribe general plans for relief. Locations with special peculiarities can then be given treatment suited to their individual requirements.

Statistics of fatal accidents do not usually form a useful basis for the study of general conditions of hazards. Being comparatively few in number they do not adequately reveal dangerous localities. Locations of danger can best be determined by a spotting of personal injury accidents. A map of this far more frequent type of accident will include most of the locations of fatal accidents, and will reveal those places that are potentially productive of fatalities and serious injuries. Such a map will be found in Figure 6.

STUDY OF ADMINISTRATIVE ORGANIZATION

The effectiveness of any system of traffic control depends upon the efficiency with which administrative agencies function. The two organizations most directly connected with the traffic operations of typical cities are the police and the courts. A survey designed to set up a comprehensive system of traffic relief cannot fail to consider these two functions of government.

A consideration of police activities will often lead to recommendations for increased personnel, a more effective distribution of the force, and more modern equipment. Most cities are definitely undermanned so far as traffic police power is concerned. Too frequently cities attempt to avoid expenditures for essential police services by the substitution of mechanical devices which may be ill suited to the requirements.

One of the chief weak points in control in most cities is the enforcement of traffic laws in the courts. The great growth in the number of comparatively minor and petty cases has

FIGURE 6

in general swamped the court machinery. This has resulted in an unwarranted laxity in the consideration of more serious offenses and in an undue inconvenience to petty violators. A critical study of court operations in connection with traffic cases will generally reveal opportunities for recommended simplification of procedure, and reorganization of court operations to render more effective service. Recent adoptions of special traffic courts, and traffic fines bureaus indicates the tendency toward more effective judicial operations.

THE FUTURE OF TRAFFIC CONTROL PLANNING

The traffic survey being a movement designed to put traffic control operations on a rational basis, it is important that its considerations and recommendations should provide for a continuation of an engineering treatment of the problem through a responsible governmental agency. The exact character of such an engineering division will depend largely upon the organization and functioning of government in any particular city. There

are certain considerations, however, which have general validity.

The traffic engineering division should be connected with one of the established engineering departments of the city government. In many cities the logical location for such a division will be in the department of public works. In general it would be undesirable to have such an agency connected with the police department, the duties of which are of a non-engineering character. On the other hand, a completely independent establishment is generally undesirable as this makes it impossible for the new agency to take full advantage of existing engineering services. So far as possible, it is desirable that the traffic engineering division as erected shall have charge of the placing, maintenance, and operation of traffic control equipment such as traffic signs and signals.

The following ordinance creating the Division of Traffic Engineering in the City of Chicago may be cited as a suitable basis for such an establishment:

It shall be the duty of the city traffic engineer to conduct studies of street traffic accidents and congestion, and other conditions affecting the safe and convenient use of the streets, to collect facts regarding the effect and operation of regulations controlling street traffic; to supervise the placing, maintenance and operation of traffic signs and signals erected by the Department of Public Works; and to perform such other duties as may be ordered by the Commissioner of Public Works.

American cities have been taken out of the pump and cesspool age by the development of water and sanitary engineering. Civic hygiene has been revolutionized by the development of a public health technique. City planning engineering has established standards for the rational and economic development of street systems. Traffic control technique promises to gain for cities maximum safety and convenience in traffic movement. In the development of this technique the traffic survey is but an elementary step.

Routing Through Traffic

By Harold M. Lewis
Executive Engineer, Regional Plan of New York and Its Environs

THERE may be conflicting ideas as to just what constitutes through traffic. Where a relatively small municipality is under consideration there is no chance for confusion. Through traffic is obviously that which does not make any stop in the community but passes directly through it in order to reach a destination beyond.

When, however, one considers a large metropolitan region or a city of a million or more population, a somewhat different definition is required. Through traffic, from the point of view of the inhabitants of any one section of such a region or city, is not only that which passes through the entire area but also that which passes through their particular district. In such cases through traffic might well be defined as that which travels more than a certain specified distance and which would, therefore, be willing to sacrifice something in directness of travel if easier and safer driving conditions and an appreciable saving in time would result. A length of haul of one and one-half miles has been found to furnish a satisfactory boundary line between local and through traffic when studying the routing of vehicles through large metropolitan areas.

Regulations will not suffice to direct vehicles over any desired routes. The only real solution consists in the provision of such facilities as may be required to permit non-stop traffic to find its way around or through a community with the least delay and inconvenience to the drivers or occupants of those vehicles, and with the least interference to the locality. Ready access from the through highway to the business and residential sections of the community is also essential.

Amounts of Through Traffic

The relative amounts of local and through traffic upon any particular highway vary between wide limits. There are, of course, many local highways which through traffic never traverses. Whenever a state highway or other important traffic route passes through a residential or business center a mixture of local and through vehicles occurs.

Major W. G. Sloan, State Highway Engineer of New Jersey, in his 1926 report to the State Highway Commission, presented counts of through and local traffic at seven points where New Jersey state highways pass through important communities. These indicated that the percentage of through traffic varied from 35 to 90 per cent of the total, with an average for the seven points of 56 per cent.

Origin and destination counts were made in 1925 and 1926 by the New York City Police Department for the Regional Plan of New York and Its Environs. These showed that on typical avenues in Manhattan 16 per cent of the total vehicles were taxicabs, which are essentially local in character. Forty per cent of the total traffic was made up of other types of vehicles, whose origin and destination for the trip they were making at the time of the count were less than one and one-half miles apart, and they were therefore classified as local traf-

fic. The remaining 44 per cent of the vehicles might be considered as through traffic. This indicates that a very large percentage of the congestion existing on the avenues in New York City is caused by the fact that they are carrying vehicles which could more advantageously be routed on by-pass highways that would carry them on the edges of or completely around the congested centers.

If such figures represent typical conditions—and the writer believes they do—adequate provision for through traffic will greatly increase the availability for local business of the main streets in any community through which trunk line highways pass.

IS THROUGH TRAFFIC AN ASSET OR A LIABILITY?

For many years local merchants and business men considered a multitude of vehicles upon the streets on which they fronted an important asset to their business. This was probably true so long as the number was not great enough to cause serious congestion and delays. At the present time it is becoming increasingly difficult for the motorist to find his way through the business areas along his route without being subjected to serious and exasperating delays. He comes to think of certain communities as disagreeable points which must be passed through because no well-paved highway enables him to go around them, and he does not select such places to stop for any purchases or local business due to the difficulty of finding room to park his car. It might be said that the lack of parking facilities is the real cause of avoiding stops in such places, but that is directly caused by the confusion resulting from the combination of through and local traffic. In many places merchants are waking up to the fact that their main business is from the local residents, and that the congestion caused by through traffic is causing such business to seek other and less congested communities.

The Westchester County Park Commission has been successful in persuading local merchants along the Albany and Boston Post Roads that their interests can best be served by the provision of new routes for through traffic parallel to the old ones but through relatively open country. It is expected that the completion of such routes, which are already under construction, will enable the older roads to assume again their proper function as business streets.

In the early days of motor traffic it was a common experience for a motorist to find well-paved and adequate highways between different communities, but stretches of poor pavement within the municipalities along his route. The local authorities had failed to maintain adequately the portion of the through route under their jurisdiction. If about half of the traffic passing over such a local street is through traffic, as indicated by the percentages already quoted, it is only reasonable that the state, county, or federal organization, which has constructed the connecting highways, should contribute to the construction and maintenance of the link necessary to enable vehicles to pass through or around the municipality. The Federal Highway Act and legislation in most of the states now provide for such financial assistance. Such routes should go around the built-up sections, and political boundaries should be disregarded in determining their best locations.

ORIGIN AND DESTINATION COUNTS NEEDED

A logical plan for any public improvement must be based on adequate

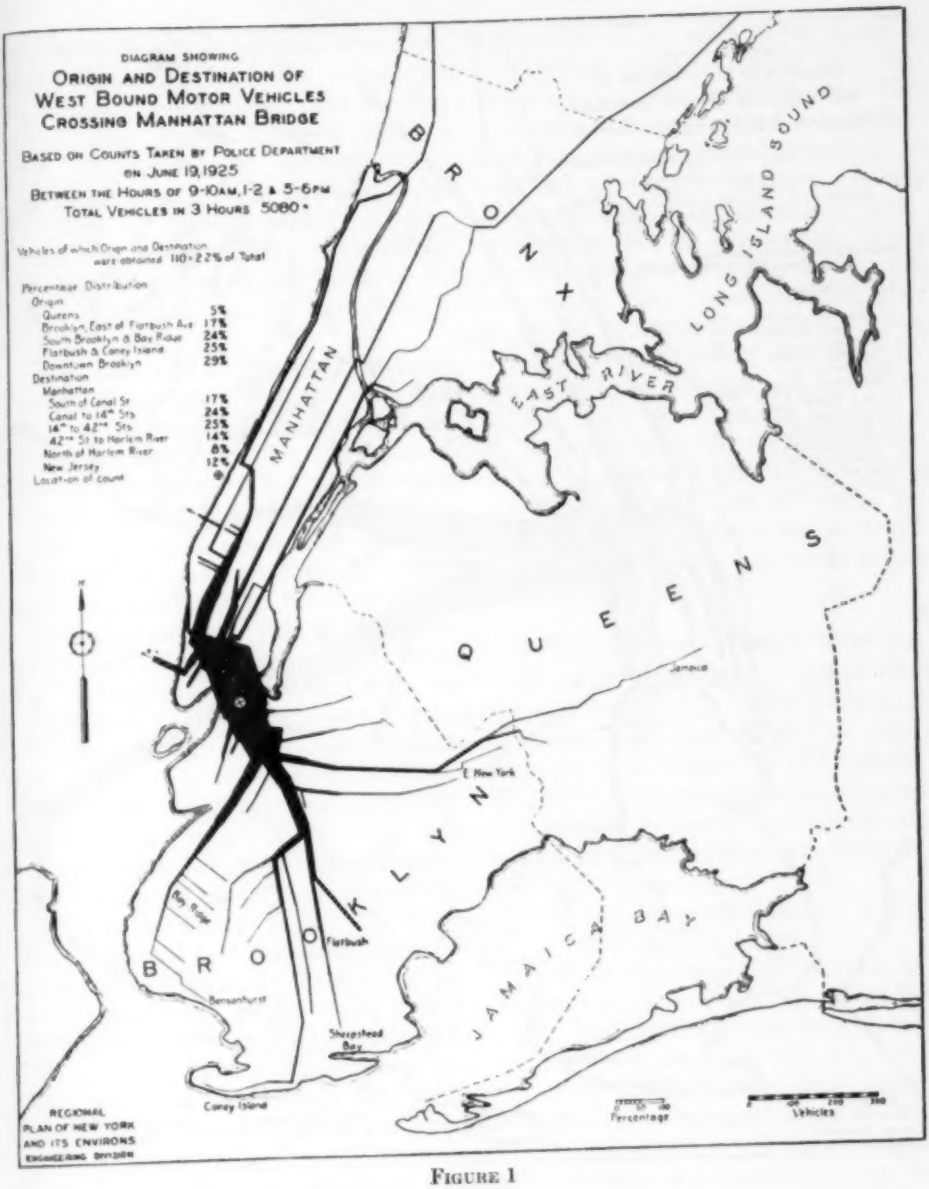


FIGURE 1

information. In order to lay out a by-pass highway that will be both economical and efficient, information should be gathered both as to the origin and destination of the vehicles on existing trunk highways, and the savings in time and money that any new facility will bring about. Public authorities have, for many years, been taking traffic counts upon their main highways. These have, in most cases, reported only the number, and perhaps the type, of vehicles passing certain points within specified periods of time. Such counts will show where there is necessity for providing ad-

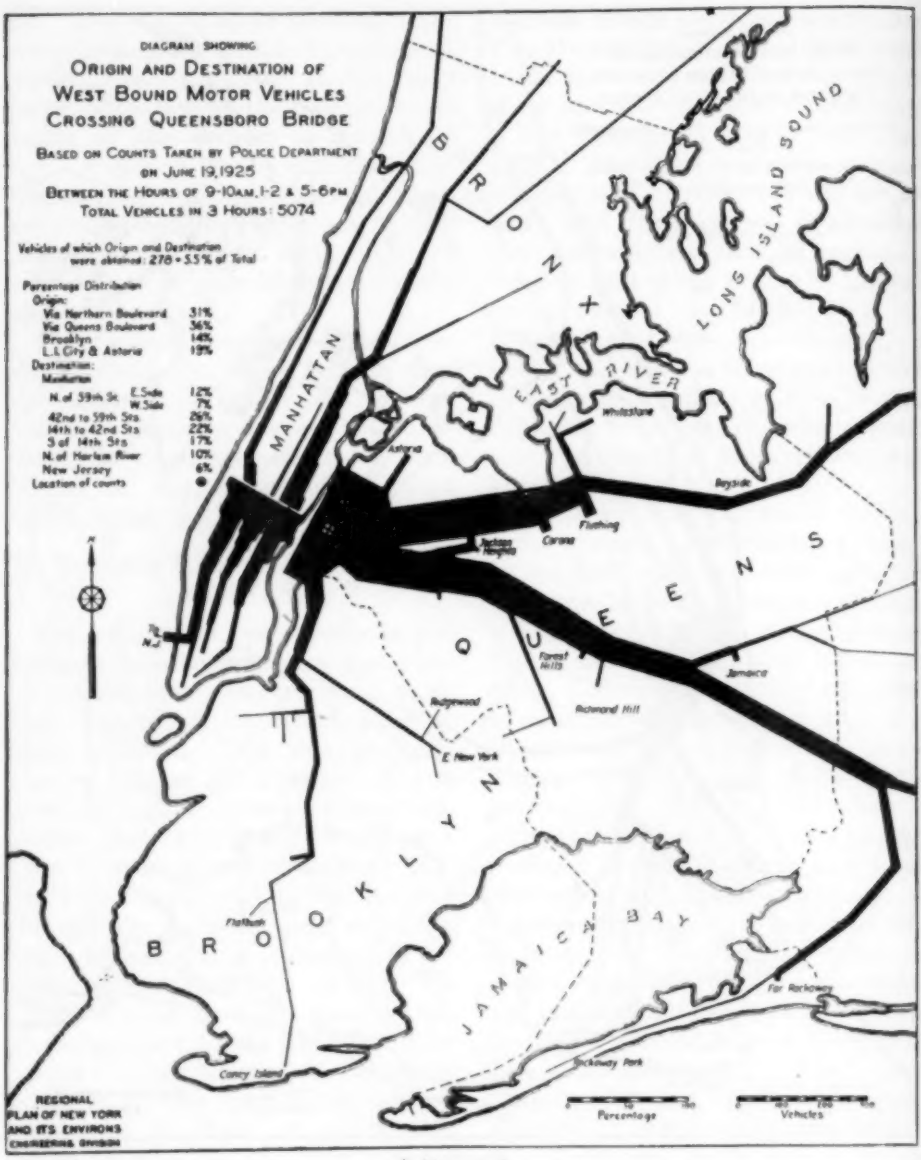


FIGURE 2

ditional highway facilities, but they are not enough to indicate the best route that such highways should follow. For this purpose it is necessary to know both the origin and destination of all the vehicles concerned. Counts of this nature are essential for the proper planning of highway facilities over wide areas.

Figures 1 and 2 show how such counts have been graphically presented by the Regional Plan of New York and Its Environs. One of these shows the distribution of vehicles crossing the

Manhattan Bridge between Brooklyn and Manhattan, and the other the distribution of vehicles crossing the Queensboro Bridge between Queens and Manhattan. In making these counts information was obtained as to the type of vehicle—truck, private passenger car or taxicab—the number of passengers carried, and the approximate percentage of full load carried by all trucks.

The drawings indicate to what extent by-pass routes around or on the edges of Manhattan Island would relieve the congestion on the interior streets. They have led to the conclusion that the most logical method of providing such relief is by the construction of adequate through routes on the easterly side of the East River and on the westerly side of the Hudson River, coupled with express highway routes on both waterfronts of Manhattan which could accommodate the long haul traffic within that borough.

Generally speaking, time is money and a calculation of the time lost, due to congestion or gained by adequate by-passes, can readily be converted into financial loss or gain. The New Jersey report of Major Sloan, already referred to, estimated the time lost by through vehicles, at the seven points studied, as the difference between that which would have been required to cover the distance through the community at a rate of 30 miles per hour and that actually consumed. Assuming the value of the car minute at one cent, it was computed that the financial loss would justify expenditures varying from about $500,000 to almost $3,000,000 "to effect a separation of this through and local traffic by carrying the through traffic around the town rather than through it."

The rate of one cent a minute is a very conservative figure, as other authorities have used three cents a minute for passenger cars and five cents a minute for motor trucks. The obvious conclusion is that a considerable expenditure of funds for such projects is economically justified. It has been estimated that the cost of vehicular congestion on Manhattan Island reaches $500,000 per day, and in the entire New York region amounts to as much as $1,000,000 per day. This, of course, cannot all be eliminated by a separation of through and local traffic, as many other causes contribute to this delay, but the total cost could be very materially reduced if business streets could be used primarily for business vehicles, and through traffic could be diverted to routes laid out to serve such traffic.

HOW TO ROUTE THROUGH TRAFFIC

Almost anyone would admit that through traffic should be routed so as to avoid the most congested points where delays would be unavoidable. The by-pass highway is the logical solution. Such a route can avoid the congested center in any one of the following three ways:

1. It can be carried on one side of the business center.
2. It can traverse the business district on a relatively direct line over a viaduct or embankment which would be free of any interferences from cross traffic.
3. It can be depressed below the normal street level and carried in open cut or tunnel directly beneath the business center.

The first method is the one that would generally be used. The by-pass route must be short enough so that it would not require a greater length of time than is required by the direct route, including any delays at points of congestion. This applies particularly to business traffic where the

element of time is an important factor. Pleasure traffic might be glad to utilize a by-pass route around a congested district even though it added somewhat to the time of travel. The freedom from delay and the safer driving conditions might more than make up for the time lost. Passenger car traffic is sometimes all considered pleasure traffic, but it should be remembered that a large part of the passenger car traffic in the metropolitan center may be just as much business traffic as the motor trucks are.

Where the topography or the size and shape of the congested area prevent a satisfactory location for a route around the district the second or third method may be employed. The former may consist in a two-story street, such as Michigan Avenue or Wacker Boulevard, in Chicago, or the elevated driveway proposed for the West Side of the borough of Manhattan, in New York City. In other cases it may cross over areas where a surface roadway cannot readily be developed in connection with it. Examples of this would be a part of the proposed West Side Elevated Driveway in Manhattan which would cross the New York Central freight yards between 60th and 72d Streets, or part of the Saw Mill River Parkway in Westchester County which follows a side hill in the easterly part of the city of Yonkers.

The third method can be used to best advantage where the route can follow a water course or must cross a built-up area where an elevated roadway would be decidedly objectionable. The Bronx River Parkway in Westchester County utilizes the depressed method for passing through built-up communities, such as Mount Vernon and White Plains. By utilizing undeveloped and in many cases waste lands along the Bronx River, this highway was brought close to the center of these communities without prohibitive cost. The state of New Jersey is constructing a through highway route in open cut and tunnel through the ridge in Jersey City. This will serve as the main New Jersey connection for the Holland Vehicular Tunnel under the Hudson River which is expected to open in the fall of 1927. A vehicular tunnel has been proposed to extend the full width of Manhattan Island as an extension of a proposed vehicular tunnel under the East River to connect Manhattan with Queens and Brooklyn. This plan includes the construction of several inlets and outlets in Manhattan at widely distributed points.

The modern city has grown to such a size and the vehicular traffic which serves it, or passes through it, is proportionately so much greater than before that a different type of street plan is now required. The wheel, with its hub and spokes, has sometimes been referred to as an ideal street pattern. Some of our cities have been laid out on such a plan where highways correspond to the spokes, all radiating from the civic or business center of the community. Such a community is considered fortunate in that there is convenient access between its center and outlying sections. Many other communities which started with a "Main Street" have, as the center of their street plan, not a single point but a long line from the ends of which there may be radiating highways to other points. Both these types of layout are indicated diagrammatically in Figure 3. They present serious problems when called upon to take care of large amounts of through vehicular traffic.

A far preferable scheme, to meet modern conditions, would be to substitute for the focal point, or "Main Street," a loop highway which would

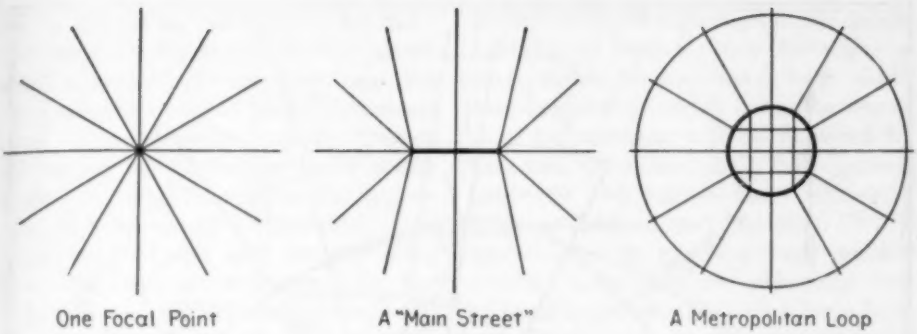


FIGURE 3

VARIOUS TYPES OF STREET PLANS SHOWN DIAGRAMMATICALLY

circumscribe that section of the city which does, or is destined to, include the main business facilities. This should be crossed by one or more direct highway routes along the main axes of the community and the radial routes should converge upon the edges of this loop district, *i.e.*, upon the loop highway rather than upon the business center. Such a scheme will permit through traffic moving from one part of the city to another to pass around the business district, and if destined therein to enter it upon the highway that will take it most directly to its point of destination. If the street plan also contains an outer belt highway which will pass through the edges of the entire town this will be utilized by long haul through traffic, which will thus avoid not only the main business center but the inner loop which circumscribes that center. A diagram indicating this arrangement is also included in Figure 3.

Such diagrammatic representations are sometimes open to criticism on the score that they are not readily applicable to specific problems. There is probably no metropolitan district which is more broken up by waterways, mountain ridges, etc., than the New York region. If such a scheme could be applied in that case it is fairly safe to assume that it would also be adaptable to other communities. Figure 4 shows how the Metropolitan Loop Diagram has been applied to New York and Its Environs. In this case the metropolitan district is considered as consisting of two parts—the business center east of the Hudson River in New York City, and that centering in the New Jersey communities on the west shore of the Hudson River. The metropolitan loop has been laid out so as to enclose both these districts as part of the same metropolitan center. The diagram has proved very useful in the highway studies made by the New York Regional Plan Committee.

TYPES OF ROUTES REQUIRED

It has been suggested that highways should be constructed especially for motor truck transport between the principal metropolitan centers in the entire country. A segregation of such traffic from passenger vehicles would be desirable for many reasons. It would cause greater efficiency due to separation of vehicles traveling at different speeds. It would decrease the danger of accidents and it would afford very much pleasanter traveling for the passenger car.

Such segregation does not necessarily entail the construction of motor truck highways along separate routes. The same result can be obtained by

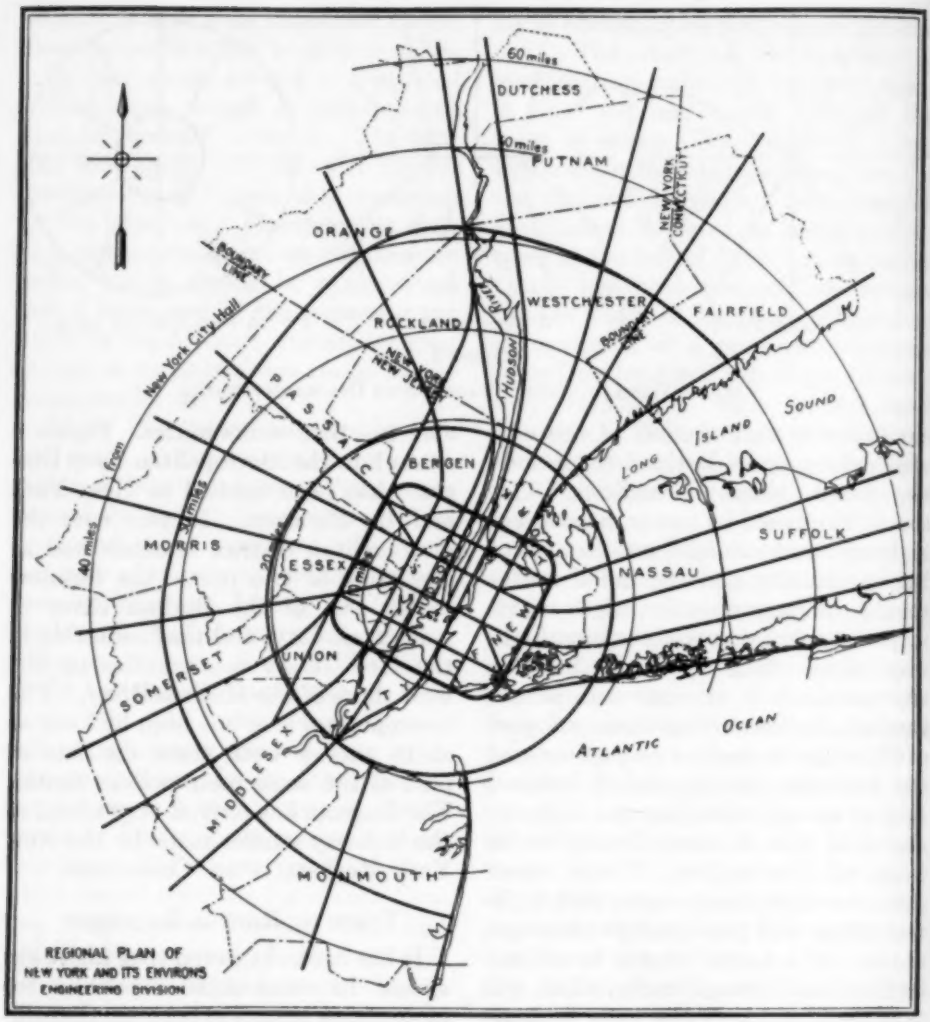


FIGURE 4

APPLICATION OF METROPOLITAN LOOP DIAGRAM TO THE NEW YORK REGION

providing within a single right-of-way separate roadways for each type of traffic. This requires a much greater width of right-of-way than has been customary, but is probably the most practicable method. It leads to what has recently been called the "superhighway." The city of Detroit and the surrounding counties have developed such highways on rights-of-way 204 feet in width. If separate motor highways are to be constructed they should approximate railroad lines in their grades and curvature, and might well be toll roads with points of entrance or exit only in the vicinity of the larger communities.

There is an element of danger to pedestrians crossing roadways of exceptional width, and there is also a considerable decrease in efficiency per lane of vehicular traffic as the roadway

width increases. In general six moving lanes are about the maximum advisable on a single roadway, and this requires safety isles at pedestrian crossings. More attention must be given to separation of grades at intersecting highways along through traffic routes.

In the center of a community the main part of the cost of providing routes of adequate capacity is for the right-of-way and the cost of improvement is relatively small. For example, the Sixth Avenue Extension in Manhattan, New York City, will cost about $8,700,000 for the acquisition of property, while its improvement is estimated to cost about $500,000. For parts of a properly laid out by-pass highway the reverse may be true. This points to the conclusion that the urgent problem is the acquisition of rights-of-way for an adequate system of through traffic and by-pass highways, which can be improved progressively as the traffic demands increase, and which will permit the separation of grades at important points without acquisition of or damage to adjacent property.

If such a program is properly presented it should be possible to obtain the dedication to the public, by private owners, of much of the right-of-way through undeveloped country. In the system of super-highways in the neighborhood of Detroit, over 200 miles of such rights-of-way have been dedicated, and that which it will be necessary to purchase will be financed by the not to exceed half mill general property levy within the counties of Wayne, Oakland, and Macomb. While the donors in this case are public-spirited men, they are primarily men of keen business vision who have been quick to see the advantages which the execution of such projects would bring to themselves as well as to the general public.

The solution of the through traffic problem thus lies in broad-visioned plans based upon accurate and carefully prepared information. In general through traffic routes will require rights-of-way of not less than 200 feet in width. The important step is to have them definitely laid down and the necessary land transferred to public ownership.

Local owners and communities should, by well-directed educational campaigns, be brought to realize the advantages which will accrue to themselves and should contribute to the acquisition of land. Improvements can be carried out progressively and should be the function of public agencies representing the larger areas affected.

Planning and Re-planning the Street System

By Lawrence V. Sheridan
Consultant on City Planning, Indianapolis

EVERY American community is confronted today with the necessity of providing additional street capacity for its rapidly increasing traffic. The problem is much more serious in the larger cities than in the smaller ones, but all have the task to some degree. No one has been able to forecast the ultimate volume of traffic which will result. A few years ago a prediction was made by Henry Ford that the saturation point would be reached when thirty million automobiles were in operation in the United States. A recent report shows that there are more than twenty million now and it is not unreasonable to predict that within a very few years the thirty million point will have been passed. The effects of traffic congestion are felt, to some degree, in every city. Inconveniences and delays of many sorts result.

Effects and Causes of Congestion

The most apparent effect of congestion is the slowing down of traffic. Every one who drives a car has experienced the necessity for proceeding at slow speed, particularly through the downtown streets; of applying the brakes quickly to avoid accidents; or of taking chances of accidents in order to pass slow moving traffic. Unquestionably this retardation results in greatly increased costs to every one operating a car. Deliveries from stores and the hauling of supplies and materials cost more on account of traffic congestion. The wear on machines is greatly increased, and results in higher maintenance costs. Estimates have been made of the increase in operation and maintenance costs of motor cars and, while these are all guesses to some extent, they point unquestionably to the fact that congestion increases costs tremendously.

One of the chief causes of traffic congestion is the interference of local and through traffic. The street plans of American cities have resulted in converging all thoroughfares upon the central districts. It is a very definite principle of traffic movement that convergence produces congestion. Taking almost any American city as an example, it will be found that local traffic and traffic which is merely passing through the city interfere in the business district. Most of the through traffic has no reason to be there, except that it is forced to follow a route through the center of the city in order to reach the outlet thoroughfare which it is seeking.

It is a basic principle of the movement of traffic that converging lines produce congestion. There are streams of traffic moving constantly over the greatly increasing mileage of improved highways throughout the whole country. A network is formed by thousands of intersecting roads. Each intersection is a point of convergence. Two vehicles approaching it at the same moment must slow down or run the risk of a collision. A momentary delay is caused by this simplest form of convergence. Certain highways following direct lines between centers of population are more attractive to traffic. The traffic from less important highways converges upon them, con-

stantly increasing the volume and consequently the congestion.

Purely local traffic occasioned by the necessities for delivering purchases and hauling supplies, and by roving passenger and pleasure vehicles, frequently interferes with the passage of traffic originating outside of the city and destined for points beyond. Internal traffic circulates in all directions, and the many points of convergence slow up the whole movement. It is obvious that the principal source of traffic congestion is the convergence upon a city of masses of through traffic and the convergence within the city of both local and long distance traffic upon the central business district and important commercial and industrial subcenters.

EFFECT ON BUSINESS

Traffic congestion is producing serious inconvenience to business, shoppers, and workers. Merchants have become accustomed to believing that the greatest volume of business was probable at points of densest congestion. There are limits to this principle, however. When congestion reaches a point where it is impossible to find parking space in the central business district, the need for outlying stores becomes apparent. Such stores would be situated usually at the intersections of important thoroughfares but removed from the dense congestion of the business center and would provide ample parking space in the neighborhood. The splendid business district in Kansas City, near the entrance to the Country Club district is a fine example of the fulfilment of this need. Shoppers show their appreciation of the opportunity to park near the point where purchases are to be made. It is quite evident that if through traffic, which has no reason for coming to the business center, can be eliminated, the convenience of shopping will be greatly promoted and merchants will benefit by increased purchasing and reduced cost of deliveries.

A further cause of traffic congestion in cities is the mixing of all classes of traffic on nearly every street. Heavy trucks, which must of necessity move slowly, are often trailed by long lines of light cars, which cannot pass the trucks safely. This has led to the establishment in many cities of boulevards for rapidly moving passenger traffic. Larger cities will eventually establish streets for heavy trucking exclusively.

BAD ADVERTISING CAUSED BY INADEQUATE STREETS

Every one who has approached a city over a wide road and then has been forced to slow down unreasonably while passing through narrow, congested streets in the business district, losing much time and being greatly inconvenienced, has retained a strong feeling of resentment towards that particular city. This resentment is multiplied by the many people who are subjected to similar experiences, until the feeling becomes general, and a positive desire to avoid that city has been created. The city suffers from such bad advertising. On the other hand, if through traffic is directed around the points of greatest congestion, avoiding inconvenience both to local and through traffic, a good impression is created, the city's reputation for progressiveness and thoughtfulness is increased, trade is fostered and good advertising results.

Accidents, due to congestion in traffic, are on the increase. There are many small accidents such as the breaking of fenders or bumpers, which are never reported, but which are a source of inconvenience and slight damage to a great many car owners. A car

without dents in its fenders is a rarity and most of these small damages are incurred in crowded districts.

PHYSICAL CAUSES OF TRAFFIC CONGESTION

In the preceding paragraphs the fundamental causes and effects of traffic congestion have been briefly discussed. Mention has also been made of the result of convergence of traffic. There are many physical situations which require correction and which contribute to the production of traffic congestion. These conditions are the result of inadequate planning or the lack of a plan of the street system.

Narrow Streets

Narrow roadways are probably the most common physical element producing congestion. On many downtown streets, which are parts of main highways, there is actually less capacity for moving traffic than exists on the highway beyond the congested limits. A state highway with an eighteen foot paved roadway approaches one Indiana city. When traffic originating on the country road reaches the downtown section, it is forced through a forty-foot roadway, which bears a double track street car line, and along which flat-to-the-curb parking is permitted. Street cars operate frequently leaving no passage for moving traffic. The only way open to automobiles is to follow the street cars. There is little possibility of widening this street. Its total width is only sixty feet, the ten foot sidewalks are a necessity and expensive buildings line it on either side.

Steep Grades and Jogs

Strict adherence to rectangular plans in many cities has resulted in extremely heavy grades, difficult and expensive to correct and productive of delays to traffic. Jogs often occur. In the days of horse drawn traffic jogs and grades were not so serious. All traffic moved slowly. Now each of them is a direct cause of traffic congestion.

Rough Pavements

Rough or poorly maintained pavements are another direct cause of traffic congestion. A deep chuck hole in the street effectively reduces the roadway capacity, as every driver swings to one side or the other to avoid it. A smooth pavement will speed up traffic without increasing traffic dangers. A smooth pavement as contrasted with a rough, treacherous surface will produce as great an increase in traffic capacity as the addition of width to the street sufficient for another line of traffic in each direction.

Railroad Grade Crossings

Railroad grade crossings play a great rôle in producing traffic congestion. Much progress has been made in the elimination of grade crossings during the past, but much more remains to be done.

Failure to Make Use of Parallel Streets

In many cities it is evident that streets paralleling densely congested traffic ways are used but slightly. In one Indiana city, the bulk of the traffic from north to south passes over a 60-foot street with a 40-foot roadway. Less than one-half mile from this street, and paralleling it is a 100-foot street over which only a small volume of traffic passes, due entirely to the fact that no direct connection from the state highway, the source of most of the traffic approaching the city, has been provided.

Such a connection would afford great relief and would incidently provide access to three other parallel streets, each of 60-foot width, so that the capacity available for through traffic would be more than quadrupled.

ORIGINAL PLANNING AND REPLANNING

Relief of traffic congestion involves both the planning and replanning of the street system. Slight opportunity for original planning is afforded within the city limits, except occasionally in outlying sections. Relief in the built up districts can be obtained only through revision of existing streets.

Avoidance of Interference of Local and Through Traffic

It is essential, in designing a revised street system to correct basic faults of traffic movement as well as physical defects. The principal factor contributing to traffic congestion, is the interference of through and local traffic. Through traffic is that traffic which originates beyond the city and is destined for points outside the city. In a large city there is a semi-through traffic which passes from one section of the city directly to another section. Through and semi-through traffic does not need to visit the congested center although it is often forced to on account of defects in the street system. It can make better time if directed around the congestion and traffic which has business there and is much less inconvenienced.

Widening of Streets

The widening of streets, now used as principal thoroughfares, is the most obvious way in which to provide greater capacity for traffic. These streets, usually the most direct routes, are generally important shopping streets and, even though widened to provide space for all traffic using them, the interference of local and through traffic continues. The widening of certain main streets may be demanded to afford greater convenience for local traffic only. The cost of widening main business streets is very large. It has been proved in many instances that property owners benefit greatly by such widenings, but it is difficult always to convince them of this, where the first cost runs into large figures. A property owner usually figures the cost of his property in terms of front foot values. As a matter of fact, if he will consider that, in effect, he merely cuts a strip from the rear of the property and pushes the remainder of the property back, retaining the frontage, he should realize that he does not in any way destroy the value of the property but rather increases it. The mere widening of a street, however, does not completely solve the traffic situation, because it does not eliminate the interference of local and through traffic.

Use of Parallel Streets

The use of parallel streets may be made possible by the building of connecting streets beyond the points of greatest congestion so that traffic can be distributed easily and conveniently among several streets, instead of being almost forced to use one. The connection may be in the form of a short diagonal street, similar in effect to the ladder track in a railroad yard which connects several parallel switches. The use of several streets in place of one obviously reduces the density of traffic, but it will not avoid interference of through and local traffic if the parallel streets are all business or industrial streets.

Diversion Thoroughfares

The most effective way in which to avoid completely the interference of through and local traffic is by the construction of a diversion or by-pass thoroughfare. Such a street would leave the main highways near one edge of the city and connect with it again beyond the developed districts on the other side. In almost every case such a street would be somewhat longer than the more direct route through the business center, but the avoidance of delays would result in more rapid safe passage

through the city. A diversion thoroughfare should be of ample width to accommodate all of the traffic using it. Generally it would pass through open country or through residential districts, which would reduce to a minimum the cost of property for widening. The only objection to handling through traffic over a by-pass thoroughfare would come from merchants in the downtown districts who do not yet appreciate that their business is not aided by a great volume of through traffic, interfering with local custom and the operation of their own vehicles. It is an advantage to have proper signs at the diversion points indicating to through traffic the route to follow if purchases are to be made or stops at hotels are desired.

Paving Program

A paving program is not necessarily a part of a plan of the street system. Nevertheless it is important that every city should adopt such a program. The principal streets of the thoroughfare system should be smoothly paved and thus aid in the safe expedition of traffic.

Eliminating of Grade Crossings and Physical Defects

A study of the street system and a program for its improvement should include the elimination of grade crossings, jogs, steep grades, bad curves, and points where clear vision is obscured. By-passes around steep grades, while longer, may make possible more rapid passage. Where it is possible, grades of very heavily traveled main thoroughfares should be separated. The topographical situation may often make such separations possible at slight cost and the result will greatly benefit traffic movement.

Subdivision Guide

In undeveloped sections of the city and its environs opportunity is afforded for original planning. In many states authority over the subdivision of real estate has been assigned to City Planning Commissions. In Indiana, for example, each plat of a subdivision must be approved by the City Plan Commission before it can be filed and recorded in the office of the county recorder. This authority extends five miles beyond the city limits, and makes possible the preparation and enforcement of a street plan. It has been demonstrated that nearly all property owners and real estate men are more than willing to coöperate with the city in working out and adhering to such a plan. More street planning can be accomplished through the platting of subdivisions than in any other way and the problem of costs for acquiring property is practically eliminated.

Every city planning commission should have a plan of the city and environs, including a system of proposed major thoroughfares and a general scheme of subdivision of undeveloped territory. The plan of major thoroughfares should be adhered to strictly as new roads are projected or plats are designed. The scheme of minor streets may be varied to suit the particular interests of the property owners, but should be followed in spirit. In making such a platting guide, either by the aid of a topographical map, if the city is fortunate enough to have one, or through a reconnaissance survey, a thorough knowledge of natural features which would affect platting is obtained, such as stream courses, ravines, hills, etc. With this knowledge at hand a system of streets, which will fit the ground, is designed and placed on the general city plan map. An economical way in which land may be subdivided is thus indicated to property owners. The size of lots desired may affect the street lay-

out to some extent, but such guides usually result in an economical and attractive development of territory around the city.

Street Widths

It is impossible to state definitely the widths which should be adopted for thoroughfares and streets. Unquestionably no main thoroughfare should be less than 80 feet in width, but local conditions may dictate much more. Neighborhood streets should have a minimum width of 60 feet. In many cities, 40-foot streets will be found and it has been quite common to plat 50-foot streets in residential districts. A street narrower than 60 feet does not provide much space for tree planting and lawns. The attractive appearance of neighborhood streets is important, and the 10-foot lawn, possible on a 60-foot street with 30-foot roadway is none too wide.

Parkways and Boulevards

The provision of ways for light, rapidly moving traffic must not be overlooked in making a plan for a street system. The most valuable boulevard street is along the border of a stream parkway. Generally the streams through a city follow diagonal courses, and make possible short cuts between important sections of the city. The parkway usually includes all low ground along the stream. The broad spaces, seldom overflowed in the summer season, are ideal locations for playgrounds. The establishment of the parkway eliminates the erection of unsightly shacks and the establishment of refuse dumps which almost always grow up along uncontrolled streams.

The driveways along the borders of parkways are often on top of flood protection levees and thus serve a double purpose. More attractive locations for passenger drives cannot be found. They play an extremely important rôle in the street system. It is often necessary to supplement the parkway drives with other boulevards. These should always be studied as essential elements of the street plan.

Spacing of Major Streets

As a general rule major thoroughfares at one-half mile intervals in each direction are found to serve well. In regions where the congressional township method of surveying has been followed, roads are quite often located at half mile intervals and logically fit into the street system. Boulevards, either along streams or following straight lines, should be at intervals of about two miles.

CONCLUSION

A street plan should include the following basic elements:

1. Means of separating the movement of through, semi-through and local traffic.
2. Means of separating the movement of heavy freight and truck traffic and rapidly moving light passenger traffic.
3. A program of correction of physical defects of the street system including:
   Street widening.
   Grade separation, both of streets railroads and of heavily traveled streets.
   Elimination of jogs, bad curves, and heavy grades.
4. A program of paving.
5. A platting guide in the undeveloped sections of the city and in the environs.

The development of a street plan is best carried out through the agency of a city planning commission composed of men whose time is not occupied largely by other duties of government, and whose technical staff may devote its energies to the one problem of city planning.

Planning the Street Lighting System

By O. F. Haas
Illuminating Engineer, National Lamp Works of General Electric Company

ADEQUATE street lighting is a municipal necessity. Its benefits are directly allied with the aims of all who are encouraging civic advancement; its services are rich contributions to the safety, comfort, and convenience of the citizens. Yet street lighting has not kept pace with the increasingly rigid requirements imposed by the rapid growth of cities and by the addition of hundreds of thousands of motor cars each year on the already congested streets.

The coming of night virtually places blindfolds on automobile drivers and pedestrians. Not only is it more difficult to see objects after dark but experiments have shown that it actually requires an appreciably longer time to see under a dim light than under bright illumination. When viewed from this angle, it can readily be understood why over 17 per cent of night traffic accidents are directly attributable to lack of adequate street lighting.

The recognized feeling of increased safety amid well-lighted surroundings rests upon a more substantial foundation than simply an inherited dread of the dangers of darkness; for the criminal makes his approach without warning when there are dark shadowy spaces, and his apprehension is made many times more difficult when there are conveniently dark passageways and alleys in which detection is difficult. A survey of street crimes from the police records in Cleveland showed that the installation of a high intensity ornamental business district lighting system was responsible for a 41 per cent decrease in night street crimes in the area in which the lighting was installed.

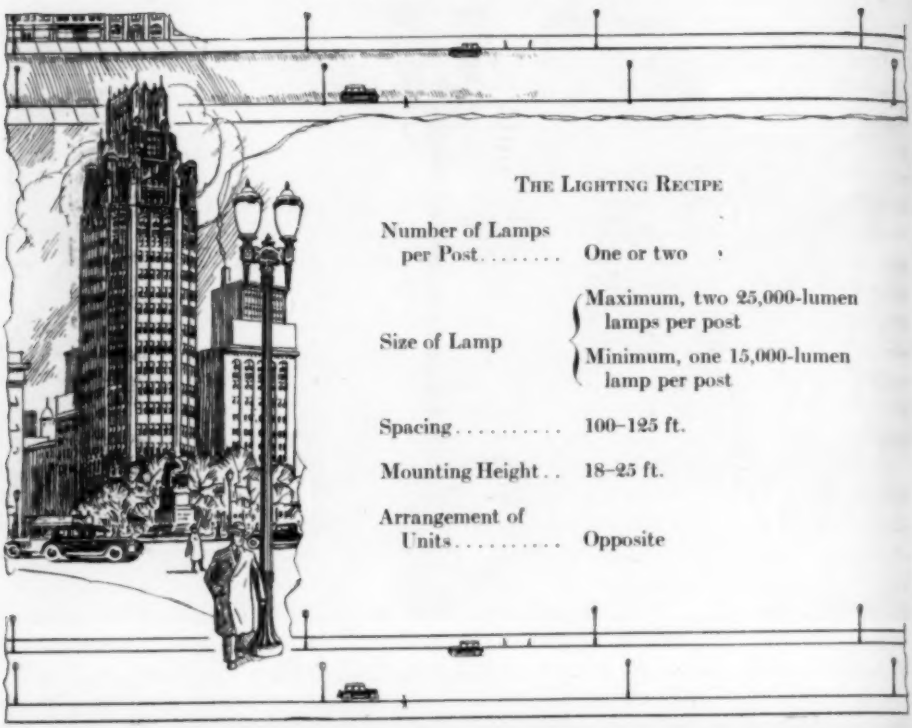
As is true for any large project, the first essential in the development of a good street lighting system is a thoroughly comprehensive plan. Briefly, this plan should consist of a careful zoning of all the streets in the city into various classifications based on their lighting requirements, and the adoption of a standardized lighting system for each classification.

The adoption of a comprehensive plan does not mean that the entire city need be relighted at one time, although in some cases this is desirable, but it does insure that the extensions and revisions made over a period of years will form part of a unified design. Otherwise a haphazard variety of conglomerate equipment inevitably results. Such a tangle is happily avoided by using for all classes of streets a "family" of lighting equipment, consisting of globes and posts of similar design but of different dimensions, and with different lamp sizes. The discussions and recipes which follow may be readily used in the working out of such a plan. There are a wide variety of globes and posts available, some of which are illustrated, which combine pleasing appearance with effective light control. Modern units present a marked contrast to the inefficient multi-lamp clusters that were at one time widely used for White Way lighting, and to the unsightly wooden-pole, mast-arm, dangling wire type which have been used extensively in the past for the lighting of thoroughfares and residence streets.

THE BUSINESS DISTRICT IS THE SHOW WINDOW OF A CITY. LIKE THE SHOW WINDOW ITS PROGRESSIVENESS IS DOUBLY ASSERTED WITH PROPER LIGHTING

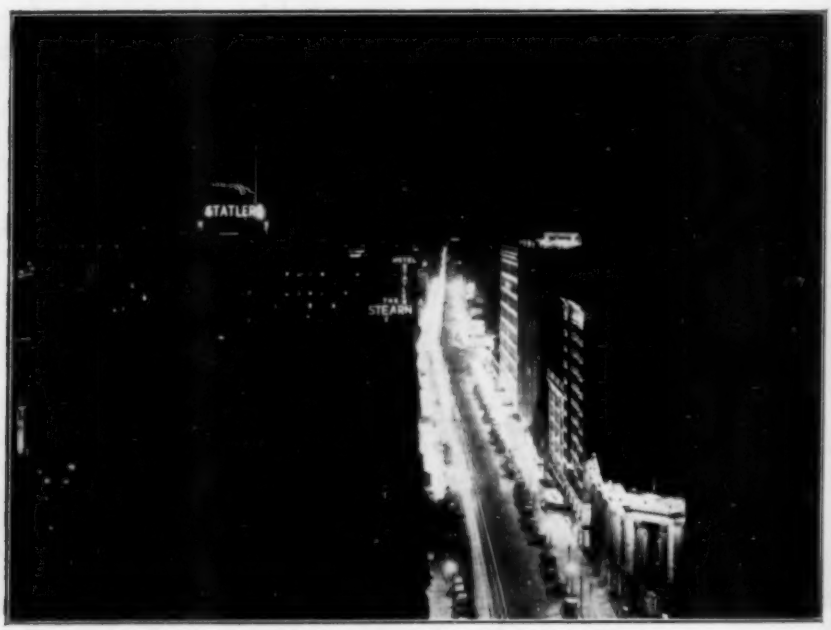
BUSINESS DISTRICTS

Cities of 50,000–500,000 Population



The Lighting Recipe

Number of Lamps per Post	One or two
Size of Lamp	Maximum, two 25,000-lumen lamps per post Minimum, one 15,000-lumen lamp per post
Spacing	100–125 ft.
Mounting Height	18–25 ft.
Arrangement of Units	Opposite



NOTE.—For *secondary* business districts in large cities see recipe on page 38.

THE LIGHTING OF BUSINESS DISTRICTS

In business district lighting esthetic considerations demand a pleasing and dignified appearance of lighting equipment. The system must be efficient, easy to install and operate, and reliable in service. The illumination provided should be sufficient to dispel gloom and to give maximum safety and convenience to both automobile drivers and pedestrians. The equipment should be so designed as to allow a sufficient amount of upward light to illuminate adequately the façades and upper cornices of the buildings.

Special equipment, construction, and maintenance costs are practically constant, depending little upon the size of lamps used; electrical energy and lamp renewals, the outstanding variables, contribute but a minor proportion of the total annual operating cost. This fact, coupled with the urgent need for better illumination, because of traffic congestion, and more liberal use of the streets at night, is responsible for the distinct trend toward the use of larger lamps in street lighting.

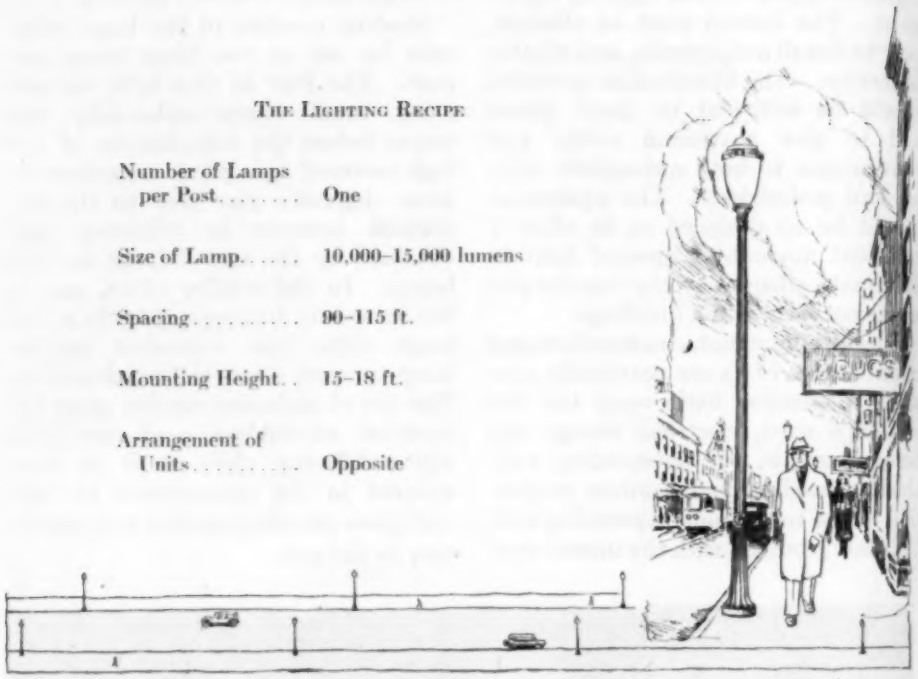
Modern practice in the large cities calls for one or two large lamps per post. The four or five light clusters using small lamps—splendidly the vogue before the introduction of the high-powered gas-filled incandescent lamp—logically give way to the important increase in efficiency now obtained by the use of large modern lamps. In the smaller cities, and in the secondary business districts of the large cities, one somewhat smaller lamp per post meets the requirements. The use of alabaster rippled glass has material advantages over the plain white diffusing glass as it is more efficient in the transmission of light and gives pleasing sparkle and animation to the unit.

BUSINESS DISTRICTS

Cities of 20,000–50,000 Population

The Lighting Recipe

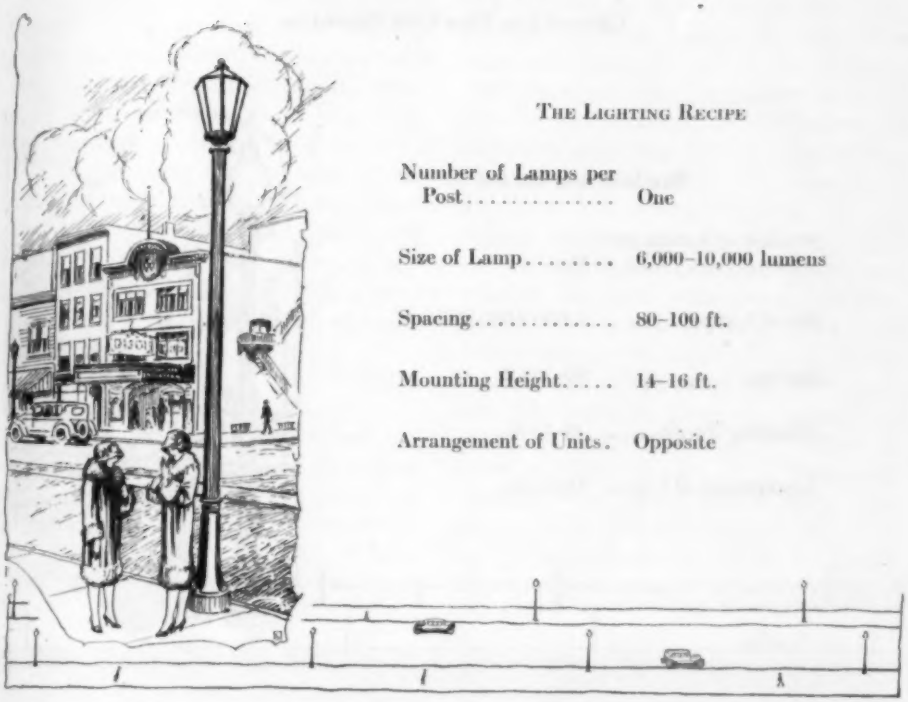
Number of Lamps per Post	One
Size of Lamp	10,000–15,000 lumens
Spacing	90–115 ft.
Mounting Height	15–18 ft.
Arrangement of Units	Opposite



NOTE.—The above plan is also applicable for the lighting of *secondary* business districts in the larger cities.

BUSINESS DISTRICTS

Cities of 5,000–20,000 Population



THE LIGHTING RECIPE

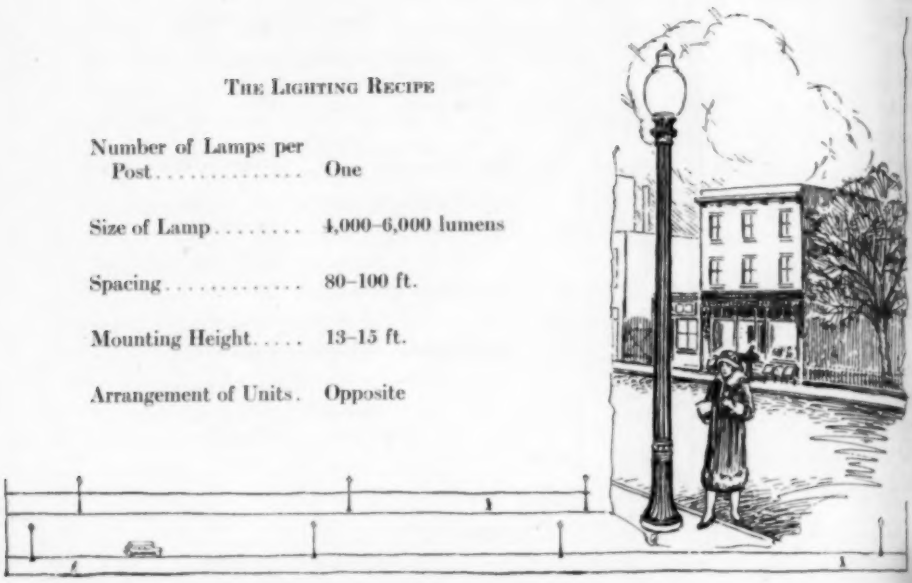
Number of Lamps per Post	One
Size of Lamp	6,000–10,000 lumens
Spacing	80–100 ft.
Mounting Height	14–16 ft.
Arrangement of Units	Opposite

BUSINESS DISTRICTS

Cities of Less Than 5,000 Population

The Lighting Recipe

Number of Lamps per Post	One
Size of Lamp	4,000–6,000 lumens
Spacing	80–100 ft.
Mounting Height	13–15 ft.
Arrangement of Units	Opposite



THE LIGHTING OF THOROUGHFARES OR ARTERIAL TRAFFIC STREETS

Thoroughfares or arterial traffic streets leading out from the business to the residential sections in the large cities, and the streets in smaller cities which are portions of main highways, have developed severe requirements for lighting under the present conditions of transportation. These streets carry automobiles driven at a relatively high speed by those who often are unfamiliar with the street. Such streets contribute a large proportion of night traffic accidents.

There are two general ways of lighting thoroughfares:

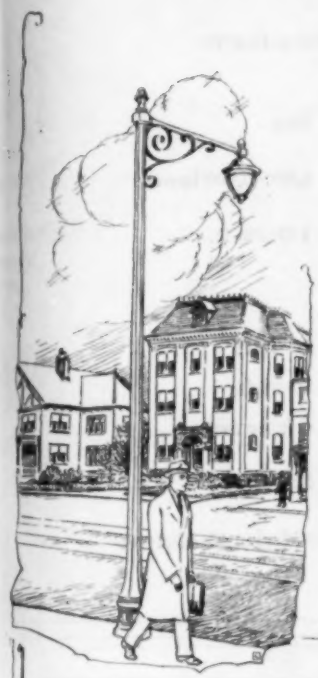
The first method is to extend the business district lighting on these streets. The urgency of economy, however, dictates usually a somewhat lower expenditure per mile. Where this is the case the practice is to omit every other lamp, leaving a staggered arrangement of units.

The second method is by the use of tall standards with bracket arms and pendent lighting units. Bracket type standards have the virtue of bringing the lamp out over the street surface, thereby increasing the utilization of light and reducing foliage interference. The lamp, when over the pavement, increases the driver's ability to see objects by silhouette against the bright area of light beneath the lamp, and against the glint reflections or sheen from the pavement surface; also, both curbs are more distinctly revealed. In general on a thoroughfare, two such bracket standards properly located are equivalent in illuminating value to three upright White Way standards carrying the same size lamp. For greatest effectiveness the bracket should be six feet or more in length, although the considerations of appearance may

A Typical Thoroughfare

THOROUGHFARES OR ARTERIAL TRAFFIC STREETS

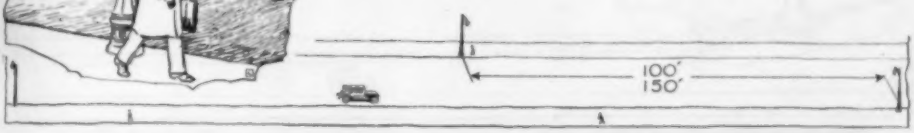
Cities of 50,000–500,000 Population



THE LIGHTING RECIPE

Number of Lamps per Post	One
Size of Lamp	10,000–15,000 lumens
Spacing	100–150 ft.
Mounting Height	
Upright Unit	15–18 ft.
Bracket Unit	20–25 ft.
Bracket Length	6 ft. or more
Arrangement of Units	Staggered

One unit for every 100–150 ft. length of street



NOTE.—For *secondary* thoroughfares in large cities see recipe on page 43.

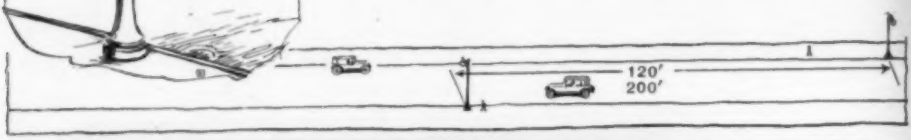
THOROUGHFARES OR ARTERIAL TRAFFIC STREETS

Cities of Less Than 50,000 Population

THE LIGHTING RECIPE

Number of Lamps per Post	One
Size of Lamp	4,000–6,000 lumens
Spacing	150–200 ft.
Mounting Height	
Upright Unit	15–18 ft.
Bracket Unit	20–25 ft.
Bracket Length	6 ft. or more
Arrangement of Units	Staggered

One unit for every 150–200 ft. length of street



NOTE.—The above plan is also applicable for the lighting of *secondary* thoroughfares in the larger cities.

A Large Variety of Equipment is Available to Meet the Esthetic Requirements of Residence Streets

sometimes result in a compromise. However, the shorter the bracket the less effective is the lighting, especially on wide streets.

Units on thoroughfares may be glaring at a mounting height which is entirely satisfactory in the business districts. In the business districts the light sources are viewed against lighted buildings, show windows and electric signs. The contrast, therefore, between the bright units and their background is relatively much

less than on the thoroughfares where the background is in general very dark. Glare depends to a large extent upon the degree of contrast between the light source and its background. This fact, together with the wider spacing, tends to make it desirable to mount the units somewhat higher on the thoroughfares.

On thoroughfares there are few, if any, building fronts which need to be lighted because of esthetic considerations; equipment which redirects the upward light on the street is, therefore, of advantage. For this purpose an auxiliary prismatic glass refractor which fits over the lamp is recommended.

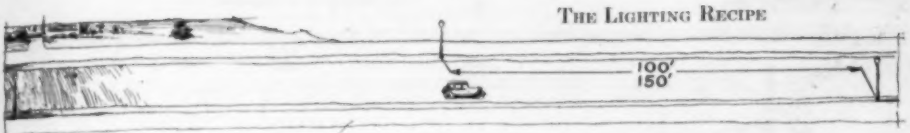
THE LIGHTING OF RESIDENCE STREETS

Where residence streets carry a large amount of through traffic they are, in effect, thoroughfares and should be lighted as such. However, in every city there is a large percentage of street mileage, known as residence territory, which is not used for through travel and, therefore, not subject to any great amount of high-speed traffic. While the lighting requirements are not as severe as on the thoroughfares, nevertheless the illumination should insure that obstructions and serious breaks or defects in the pavement will be revealed, and that children playing in the street will readily be seen by an automobile driver when going at a fair rate of speed, and that turns, dead ends, and street intersections will be definitely marked. Any unsure footing in sidewalks should be rendered visible; dense shadows from trees should be minimized; street signs and house numbers should be revealed. Enough light should be provided on front lawns and between houses to avoid dark hiding places, and at the same time care should be exercised that equipment does not appear unduly bright from porches or upper story windows.

A staggered arrangement of units is desirable in order to lessen tree trunk shadows and provide equal illumination on both sidewalks. The bracket unit has the same advantages on residence streets as on thoroughfares and, here again, the prismatic refractor should be used to obtain more efficient utilization of light on the street. The refractor serves another advantageous purpose in that it reduces the amount of light on the porches and in the upper windows of residences.

RESIDENCE STREETS

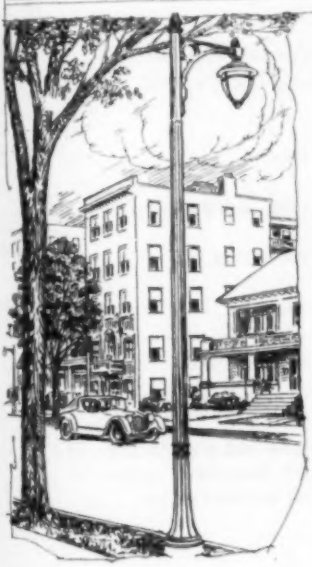
Cities of 50,000–500,000 Population



**Highest Class Residential Districts—
Ornamental Construction**

Number of Lamps per Post	One
Size of Lamp	4,000 lumens
Spacing	100–150 ft.
Mounting Height	
Upright Unit	13–15 ft.
Bracket Unit	16–20 ft.
Bracket Length	4 ft. or more
Arrangement of Units	Staggered

One unit for every 100–150 ft. length of street



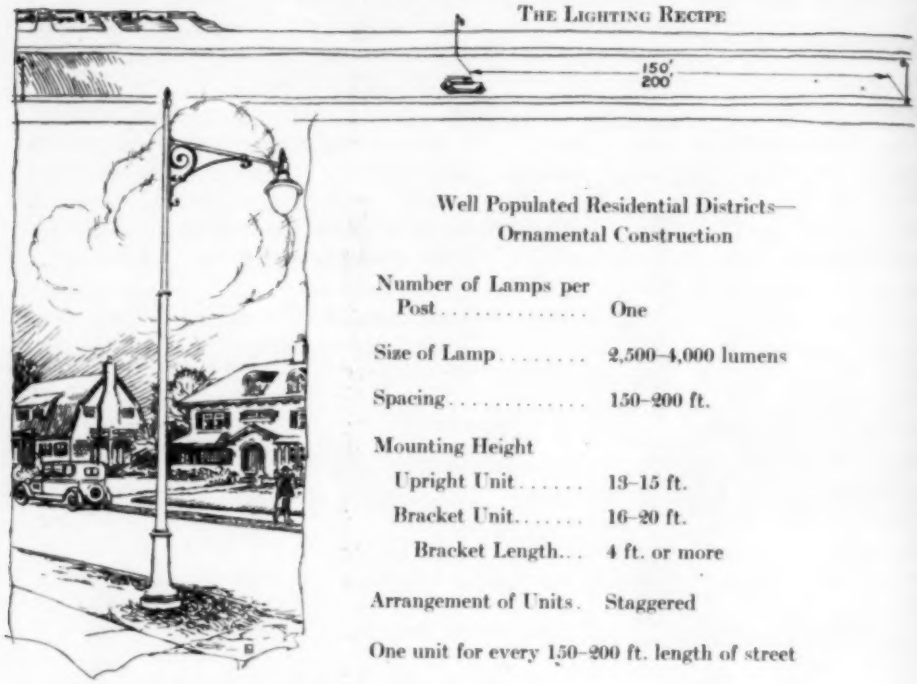
**Well Populated Residential Districts—
Ornamental Construction**

Number of Lamps per Post	One
Size of Lamp	2,500–4,000 lumens
Spacing	125–175 ft.
Mounting Height	
Upright Unit	13–15 ft.
Bracket Unit	16–20 ft.
Bracket Length	4 ft. or more
Arrangement of Units	Staggered

One unit for every 125–175 ft. length of street

RESIDENCE STREETS

Cities of Less Than 50,000 Population

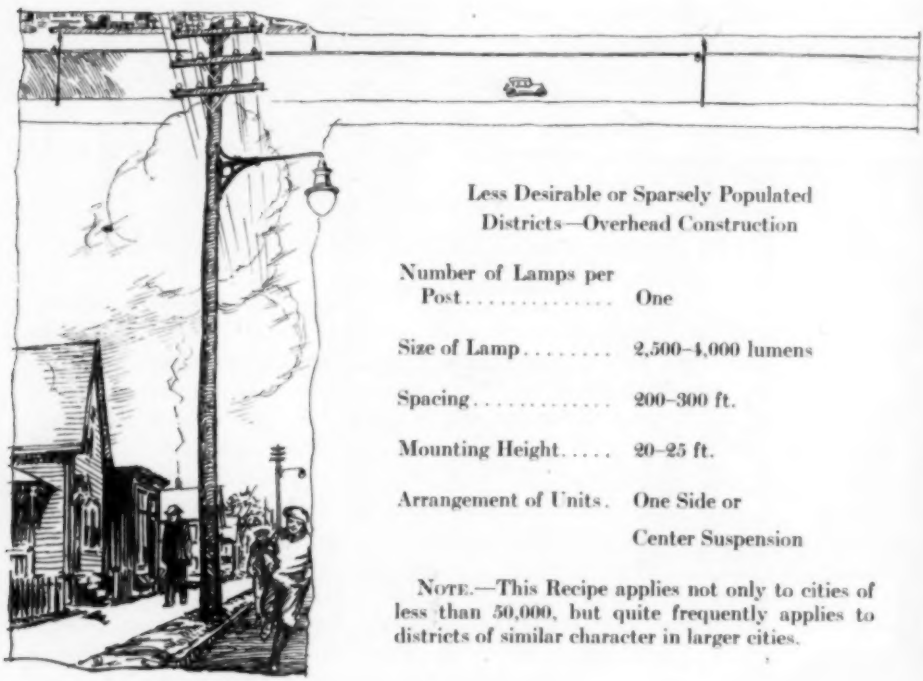


THE LIGHTING RECIPE

Well Populated Residential Districts—Ornamental Construction

Number of Lamps per Post	One
Size of Lamp	2,500–4,000 lumens
Spacing	150–200 ft.
Mounting Height	
Upright Unit	13–15 ft.
Bracket Unit	16–20 ft.
Bracket Length	4 ft. or more
Arrangement of Units	Staggered

One unit for every 150–200 ft. length of street



Less Desirable or Sparsely Populated Districts—Overhead Construction

Number of Lamps per Post	One
Size of Lamp	2,500–4,000 lumens
Spacing	200–300 ft.
Mounting Height	20–25 ft.
Arrangement of Units	One Side or Center Suspension

NOTE.—This Recipe applies not only to cities of less than 50,000, but quite frequently applies to districts of similar character in larger cities.

MAINTENANCE

The problem of the adequate maintenance of street lighting units is receiving much more attention than it has in the past. Progressive operating companies are establishing systematic maintenance schedules for the cleaning of glassware. The units are thoroughly washed with soap and water, or some other cleansing compound, from four to twelve times a year, in some cases even twice a month, depending on the needs of the particular location. Lamps which have lived long beyond their rated life and in which the filament may have sagged or the bulb blackened are removed from the circuit.

In order to reduce outages and to have all the lamps operating at an apparent normal candlepower, with the consequent improved appearance of the system, some operators are keeping records on each lamp, and after they have burned, say 1600 hours, remove them from the circuits. Others patrol the system with the purpose of removing all lamps which are apparently low in candlepower. Still others divide the territory in districts, and as soon as the outage rate becomes high in any district all lamps are replaced. The old lamps are then inspected and those which have blackened bulbs, badly pitted filaments, or other indications that the lamp has lived practically its normal life, are broken.

Modern fixture design is tending toward dust-tight and bug-proof equipment, but even with the best designed equipment, if good results are desired, a systematic maintenance schedule must be put in practice and rigidly followed.

The Spectacular In City Building

By Russell Van Nest Black

Planning Engineer for the Regional Planning Federation of the Philadelphia Tri-State District

CITIES are now undergoing a period of unprecedented growth and change. The future will experience a gradual diminishing of the larger factors in this present unstability. Adjustment to the advance of science will lessen obsolescence. More permanent and better construction will extend building life. Sooner or later will come an age of comparative crystallization of urban development. What proportion of cities, then, will have found expression through the sort of simple, orderly loveliness and livability of which isolated examples do already exist, and what proportion will have sought the way out through some form of the "super-city," as pictured by certain augurers for New York City; a city of multi-decked streets, countless storied buildings; city piled upon city *ad infinitum?*

Adjustment to Scale

Whichever the course, sooner or later the penalties of present bad proportion and utter disregard for scale in city building will force an adjustment. Old cities will have regard for these factors in rebuilding and extension, or they will fail to meet the competition of new, better planned, and better built cities and will grow obsolete and suffer virtual decay. This phenomenon is constantly before us as operative between parts of the same city. It may develop between cities and regions.

Adjustment to scale within cities may take place by either of two methods: the indefinite increase of street capacity, by widening, double-decking and other such expedients; or it may come through an intelligent limitation of the use of street frontage and of the streets themselves. The one assumes no limit to the size of cities, the other is directed toward something approaching a stabilization of urban conditions. What will be the determining factor in choice of method?

Cost will not prove a permanently unsurmountable obstacle to any project or structure that the mind of man may conceive. In the last analysis, there is no cost except as measured by raw materials and natural resources exhausted. If it pleases mankind of the future to use a part of its labor energy and a part of its resources in building many decked streets, or to burrow like moles in order that it may crowd more hundred-story buildings in a given space of land, there will be no economic or physical obstacle to its doing so. The determining factor will be, not cost in labor, cement, and steel, but cost in the advancement of civilization.

Obstacles in the Path of the Super-City

For the modern city, even at its extreme of size and congestion as now existing, few of these expedients are necessary. These spectacular remedies for urban arteriosclerosis are for the most part based upon the concept of much larger concentrations of population than the world now knows. Will the manner of living compelled by such concentration be conducive to the highest degree of livability or fruitfulness of life? Certainly this endless amassing of population will

never be an economic necessity. Limitations set by food supply and the sheer unwillingness of men to further tolerate the discomfort of crowding will begin to operate long before building sites, even at small concentration, have been exhausted. Immediately at hand are evidences that other economic factors such as the wastefulness, inefficiency, and inordinant cost of administration of the excessively large city will tend to discourage its growth. These great aggregations of population become hazards in war. Single agencies of destruction can, through the liberation of poisonous gases or attack upon such vulnerable and essential elements as aqueducts and reservoirs, cripple the operating of an entire city and, in extreme instances, demoralize and destroy an entire populace. Proponents of the great city have made much of its social and cultural advantages. It may be conceded that in the large city may be found the finest pictures, the best music, the most complete libraries, and the most superb drama, and here perhaps may take place the most brilliant discussions. But to how many people and at what cost are these things available? What is the per capita wealth of the great city in these things as compared with the per capita wealth of the self-respecting community of a hundred thousand population? An inferior bit of art that can be seen, enjoyed and perhaps participated in may be much more to be desired than the satisfaction of knowing that in some corner of your great city the world's finest symphony orchestra is playing to two thousand of your four million fellow citizens.

We have proceeded upon the assumption that great concentrations of population create land values and business opportunities at least in direct proportion to their size. We are encouraged in this belief by the occasional great fortunes made by land speculation. Fortunes lost and property eaten up by taxes escape our notice. So have the absence of amenities. No great city has yet fully met its obligations in parks and playgrounds and in beauty to substitute for the beauty of nature destroyed; and only too rarely has a city met its obligations in such decencies and bare necessities as proper sewage disposal, wholesome water, paved streets, and means of direct and comfortable communication within its confines. Great cities have played the improvident farmer bleeding his soil year after year, never putting an ounce of fertility back. The day of reckoning must come, and if the cost of restoring these things essential to livability and tolerable existence in the big city were to be paid out of those speculative profits which are credited to its very bigness, how much of balance would there be? It would be interesting to determine how the total business and real estate opportunities to be found and the money to be made in ten cities of two hundred and fifty thousand population each would compare with these same advantages in a single city of two and a half million, taking into consideration all the above factors. The very fact that the question arises is sufficient to cause no little hesitancy in assuming that present population trends will continue indefinitely. Still other factors are entering to suggest an increasing drift away from the big city. More and more industries are being attracted by the economy, convenience and livability of the smaller city. Improved motor transportation, the radio, long distance transmission of electricity, all tend to encourage a wider distribution of population.

This brief analysis of the obstacles that would appear to lie in the path of the super-city is made with the idea

of bringing within some bounds the scope of this paper. There will undoubtedly be isolated examples of the proper and needful use of most of the more spectacular features now proposed in city building. Those of architectural rather than "super-traffic" character may well be adopted extensively where monumental treatment best serves the function and goal of the city concerned. We can never have too much of the noble in architecture. Michigan Avenue and the lake front in Chicago, parts of our city of Washington, the avenues of Paris and many another example in the cities of the world cannot help but serve as sources of great inspiration and so are justified. It is the sanity of the limitless use of those expedients, designed for the handling of ever greater volumes of traffic in cities, already much overgrown that this paper is inclined to question and to eliminate in its discussion of the legitimate place of the "spectacular" in city building.

RELIEF MEASURES

We have, of course, the problem of relieving pressure already existing and of making it possible simply to do business efficiently in some of our more congested big cities. But here the extensive use of these extreme and costly relief measures is of doubtful expediency unless, at the same time, some sort of traffic wall is erected outside the congested district to prevent an immediate saturation of the new facilities and a return of conditions even worse than before. An old test of sanity was to set the patient to bailing water from a trough into which water flowed from a running spigot. If the bailer failed first to turn off the spigot he was judged insane. It is modern practice to go to endless trouble and expense in providing relief at the centers of cities without conscious effort to limit the traffic flow at its source,—bailing while the spigot flows. Future generations will draw their conclusions.

If some effective wall against traffic flow could be erected at the perimeter of cities, or if some means could be employed in the successful limitation of size of cities to whatever proportion may be found to be socially and economically desirable, then great thoroughfares might be carved through built-up city, and double-decked streets and arcaded sidewalks might be built to whatever degree necessary to eliminate existing congestion. They would then be highly effective in making now overgrown cities more comfortable, more convenient and more efficient. Under such conditions, and I am inclined to believe under such conditions only, is it likely that these superimprovements will return a benefit proportionate to their cost.

Elevated Highways

New York City may very well be justified in constructing its proposed great elevated highway around the shoreline of lower Manhattan Island, but what will even this avail if, simultaneously, bridges and tunnels of twice the capacity of this highway are built to pour their burdens upon it. Such extreme street-widening programs as that underway for the city of Los Angeles will be effective only in the degree that the flood of traffic now held to the outskirts of the city by the tremendous traffic pressure at the center, is prevented from crowding in upon the additional space faster than it can be provided, bringing confusion worse confounded. Extreme remedy must be counterbalanced by extreme prevention.

Diagonal Streets

One of the oldest and most common reconstruction proposals has been the

building of diagonal streets over the old gridiron system, usually to the very heart of the city. In certain instances such operations are justifiable and warrant the expense. Frequently the return in increased taxes due to the improvement more than pays its cost. Fairmount Parkway in Philadelphia, cut diagonally through intensively developed city blocks for approximately a mile, from the center of the city to Fairmount Park, is proving inestimable in its value to that city both as a traffic way and a thing of beauty and, incidentally, is one of those improvements that pays its way. Frequently, however, such streets, particularly when multiplied, are found to concentrate traffic in the central area and are better planned to stop at a traffic loop or traffic belt arranged some distance from the congested center.

Super-highways

Super-highways are much heard of. Their effectiveness and soundness depend entirely upon their relation to the populations they are calculated to serve and the nature of their termini, whether or not designed to receive the abnormal flow of traffic. If these highways, such as are being built by the city of Detroit, are brought to bear, in number, upon the center of any city the effort will be just as futile as traffic relief and just as disastrous to the city as has been the centralized rapid transit system of Manhattan Island. While ways in are multiplied the capacity at the center remains constant.

The time has come, however, when we must recognize the demand of and make provision for large volume, high-speed automobile traffic, both pleasure and commercial, particularly between large centers of population. The great highway, to be known as Washington Boulevard, suggested to parallel the Atlantic Coast, connecting New England, New York, Philadelphia, Washington and the South and passing just back of the great industrial and population centers of the East Coast, connecting them one with another, is an indication of the trend of highway construction of the future.

The super-highway may range up to two or three hundred feet in width. It should be free of direct grade crossings, either highway or rail, and where frontage is used for residential or commercial purposes, local roadways must be provided at the side. If the use is to be residential, heavy planting of shrubs and trees between the express and local roads will serve to blanket the noise and dirt of high-speed traffic. The side roadways would serve also to collect local traffic to be turned into the main traffic stream only at wide intervals, possibly a half mile or greater.

Arcading

The arcading of sidewalks is frequently proposed as an inexpensive alternative to cutting back entire frontages in street-widening projects. The desirability of this expedient depends somewhat on the prevailing climate. In extremely hot climates with intense sunlight, or where there is excessive rainfall, the arcaded sidewalk is a great comfort and convenience. Arcaded sidewalks are employed as a usual feature of street design in the small towns of California's Imperial Valley, which suffers extreme summer heat. In colder climates, where sunlight is sought by pedestrians, the arcaded frontage may experience some business handicap. Architecturally, the arcaded sidewalk frequently gives opportunity for interesting effect and often enables attractive show window display with minimum damage from sunlight exposure.

Subways

Subways for railway, vehicular and pedestrian transportation are perhaps the most universally adopted expedient for traffic relief. It was once thought that the solution for mass traffic handling lay in the provision of more and more subways. It is now observed that subways, in too great number and too much centralized, add to and do not at all decrease traffic congestion. They have proven to be more of traffic breeders than traffic absorbers. Rushing a greater number of people to a given spot in less time encourages more and more intensive use of land in that given area and places correspondingly increasing burden upon the already inadequate street space as again is evidenced by Lower Manhattan Island. Boston, on the other hand, by placing its street railways underground in the central part of the city, very greatly increased the capacity and reduced the congestion of its very limited street space.

The practicability of the extensive use of subways for free-moving vehicles has yet to be demonstrated. The vehicular tunnel, about to be completed under the Hudson River to connect Manhattan Island and Jersey City will undoubtedly be a great boon to transportation in that locality. The only doubt that comes to cloud its complete efficacy is the old question of what will Manhattan Island do with all the additional traffic that will pour in by this tunnel. It must be recognized that such revolutionary traffic facilities as this do not merely serve that traffic which already passes by less convenient ways. They are great traffic breeders.

It would seem that pedestrian subways might be used to advantage much more extensively than they are now, particularly in providing passage under points of extreme congestion. Experience would indicate, however, that the average pedestrian prefers the danger and delay of weaving through traffic on the level to going down or up a flight of stairs to avoid it.

It is possible that underground passageways for parcel and freight loading and unloading in congested business districts, similar to those now employed in one or two instances, might be used advantageously. Certainly some provision other than the public streets during business hours must be made for this purpose.

Elevated Sidewalks and Streets

Elevated sidewalks and elevated streets are still pretty much in the realm of the speculative. Sidewalks elevated in such manner as to liberate space at the ground level for traffic or for loading and unloading, and which will at the same time provide comfortable walking room for shoppers, have in them considerable of merit. Construction difficulties, however, migat prove a serious obstacle, particularly in installation against the frontage of old buildings. It is probable that this new style in sidewalks could be put into effect only as new buildings are erected one by one, and many years would be required to make the improvement continuous. Until continuous for lengths of at least a number of blocks, such sidewalks would not be popular or practicable.

Elevated streets are a more serious problem involving not only great expense in construction but, except where the whole operation can be built anew, involving great property damage as well. The expense, however, is not insurmountable. What should be a greater obstacle is the manner of living compelled in the use of the sub-surface streets. Where the street right-of-way is wide enough to permit of one or more elevated ways

down its center, still giving reasonable access of light and air to all levels below, then objection is lessened. But to force a great volume of traffic to habitual and constant use of an artificially lighted, artificially ventilated, closed over street with all its dust and fumes of motor-driven traffic, would seem no less than calamitous and to be tolerated only under pressure of such dire necessity as is not now in evidence.

Airplane Landing Fields

Airplane landing fields in the center of cities will become a necessity, but the development of these accommodations will depend upon the development of the airplane itself. When machines are devised that will rise vertically, or nearly so, small landing fields on the ground or on the tops of buildings will be provided.

CONCLUSIONS AND RECOMMENDATIONS

Getting back to our original assumption, every one of these extreme relief measures and a thousand others that ingenious minds may produce will find some legitimate place in the remodeling of present-day cities to meet the demands of the future. Their occasional use could do no great injury and might in some instances be exceedingly desirable. Danger lies in their intensive use as foundation for leviathan cities and in their use before other more effective and less costly remedies have been exhausted.

As for present necessity, there is probably no existing modern city which does not already have a great deal more street space than it actually needs. It is not the lack of street room that has brought about our traffic knots so much as the poor distribution of this street room and unintelligent use of the space we have. Congestion in the most crowded city is confined to the few main traffic ways and to a comparatively small central business area. Everywhere else street space is going to waste. Congestion in these limited areas is due very rarely to actual traffic volume and almost always to the clogging of flow by parked cars, the loading and unloading of commercial vehicles, the perpetual interference of every class of traffic with every other, misplaced traffic lights and numerous other obstacles that reduce actual street capacity to a small fraction of what it was intended. Before a city's resources are squandered in elaborate construction projects it might be well to investigate the possibility of making full use of accommodations already at its disposal through some such means as these:

1. The absolute prohibition of parking on the main traffic arteries of a city. (private or public garages, driveways and side streets would be adequate to all normal parking demands).

2. The absolute prohibition of parking in the congested center of the city (assuming that adequate parking provision has been made through large and convenient publicly or privately owned garages).

3. The prohibition of freight and express loading from the street during business hours.

4. The separation of classes of traffic with prohibition of horse-drawn vehicles at certain hours.

5. In extreme instances, the prohibition of all privately driven vehicles from the central area during business hours (all privately driven cars, under this arrangement, would be left at the rim of the restricted area, from where rapid and convenient transportation would be provided, possibly free, to all points within).

6. The limitation of the height of buildings to a scale in proportion to the width of streets.

All of these measures, prohibitive

as they may seem at first, would operate to increase and not at all to decrease the much valued and yet rapidly disappearing "accessibility," and would actually make for much more universal freedom in the use of our public streets than is now enjoyed. They are at least worthy of consideration along with the more pretentious devices discussed above.

This paper has been based throughout upon the assumption that most of the present-day factors of life will endure as far into the future as it is of any avail for this generation to speculate. It is assumed that the elemental human needs will remain much the same and that most of the present methods of transportation will be retained in greater or less degree; that the bulk of transportation will continue to be by land and water and that the internal combustion engine will continue to function. The transmission of electric power by air and other such revolutionary possibilities will, of course, bring changes that cannot possibly be forseen. Nor has attempt been made to anticipate that synthetic age of bottled sunlight and tabloid foods carrying with it what we would now regard as a completely artificial existence. It is possible that that far-distant generation will easily relinquish the remnants of physical freedom and will find great intellectual and possibly great spiritual delight in the super-city with its canyons and burrowings and its seething masses of humanity. But that, of all ages, will surely be sufficient unto itself. Certainly its problems are beyond the conception of the primitive mind of modern man.

Transit Facilities of Cities

By John P. Hallihan
Chief Engineer, Rapid Transit Commission of Detroit

WHEN a city arrives at rapid transit size, that is, when its requirements in mass transportation outgrow the capacity of facilities operating on the surface of its streets, the planning of its rapid transit system should receive the most deliberate consideration, for the reason that no other project for the public service has such a direct and important bearing on property values and future living conditions.

That a city may exist at all, it must have a pure water supply and facilities for complete disposal of the wastes it daily creates, but neither of these primary necessities has the influence upon the business life, the industrial progress, the sociological character, and the future growth of a city comparable to that exercised by the design of the facilities for transport of its people.

Importance of Design

In considering the character and scope of these facilities, a new element has arisen. Formerly, as cities grew and as activities concentrated, individual transportation gave way almost entirely to collective transportation. Today, the use of the automobile gives a range and freedom to individual transportation that demands its inclusion as a factor in the transit plan. The fact that the whole nation is on wheels and moves at will has removed the isolation of cities. They have become stations on national highways, and may no longer with safety plan merely for their own traffic needs. Provision must also be made for the great volume of interchange traffic between cities and between states. The plan to meet individual and collective transportation requirements must be drawn on broad lines and extend its influence far beyond the city's borders to be effective in maintaining the importance of the city as it grows.

The Transportation Street

Rapid transit, meaning the practically continuous movement of masses of people by train operation at high speed, requires an exclusive right of way.

Individual transportation in automobiles and group transportation in motorbuses require adequate street space for free movement and easy circulation of traffic.

These two requirements may be combined most economically in a single specially-designed street; on the surface on a single-level street where width of right of way is obtainable, or with the rapid transit lines underground or overhead on a two-level street where existing surface conditions must be maintained. They can be made to fit into each other in the major portion of the area of any city.

Characteristics of Growth

Conditions that may be regarded as crystallized, that is, where development has been so intensive and property values so high as to prohibit material change in the street system, are usually found to exist in but a relatively small section of the total area of most cities. Within this territory, the congested traffic zone coincides

with the highly developed business zone and occupies an area rarely exceeding that of a circle with a radius of a mile.

Outside the central area, cities are usually in a transitional stage for a considerable distance and more susceptible to adjustment of street systems and travel routes in the interest of greater freedom of traffic movement. This transition zone may extend to the five-mile circle and is usually fairly dense in point of residential and industrial occupancy. In the sparsely developed area on the edge of the city, there are seldom found obstacles of sufficient importance to prevent the creation of a system of trafficways, adequate for any need of the present or future.

Cities are like individuals. They consider the future only when forced by pressure of circumstance. It is only when the volume of street traffic becomes so great at the center of business activities, as to make the use of individual transportation a hardship instead of a convenience, that measures looking to permanent relief are considered. Measures of relief consume

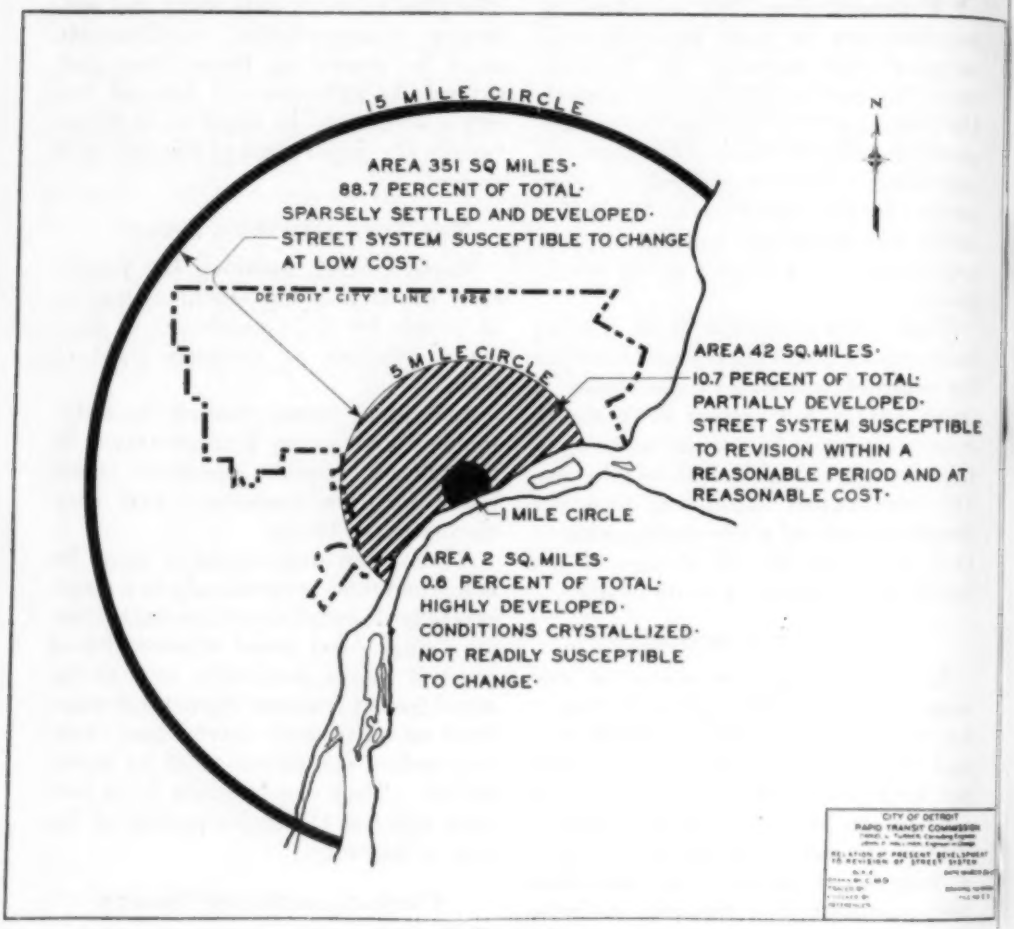


FIGURE 1

much time in planning and more in putting the plans on a firm legislative and financial foundation. More time is consumed in adjusting public opinion to the reluctant conviction that such measures must be vigorously prosecuted to accomplishment if the city is not to be choked by its own activities. Good design requires that considerations of immediate relief and local interest be made subservient to the broader consideration of permanent freedom for future growth in the interest of the city as a whole.

In Detroit which may be taken as typical of cities of a million population, the land area within the mile circle is 2.2 square miles, between the mile circle and the five-mile circle 43.2 square miles and between the five-mile circle and the fifteen-mile circle 351.1 square miles or practically as 1 to 20 to 160.

That is to say, in the territory of approximately 400 square miles (395.67 in the 15 mile circle) likely to be included within the city during the next 10 years and densely peopled within the next 50 years, 88 per cent of the area is now open to the creation, at nominal cost, of a system of trafficways that will adequately serve the city when its population shall have become five million; 11 per cent of the area is now open to the adjustment of its street system to conform to the design of the outer territory within a short period of time and at reasonable cost; and in less than one per cent of the city's area is it necessary to accept the existing street system as it is without material change.

STREET SPACE REQUIRED IN A MODERN CITY

The skyscraper design of the modern city has tremendously increased the demand for street space at the point where the street widths have been rendered inflexible by the very development that produces the need for additional space.

It is a great convenience to have the civic and commercial activities, the shopping facilities, the banks, the hotels, theaters, and numberless accessory services concentrated within easy walking distance of each other, but when in the growth of these activities the element of street design is overlooked, it becomes a costly convenience.

The street space designed to serve a 4-story town cannot be stretched to meet the needs of a 30-story city.

The street width becomes rigidly established at least for the life of the buildings, as soon as the abutting land is solidly built upon with important structures, and the greatly increased requirement for pedestrian and vehicular traffic must be obtained either by the creation of new streets overhead or underground, or by a change in the mode of travel, or by the use of both expedients.

For example, the sidewalks in the business section of most cities are 15 feet wide. The pedestrian capacity with pedestrians moving freely at two miles per hour is approximately 13,200 persons per mile, but this number can be easily housed in a single block of 30-story buildings and the sidewalk available for their use around the whole block would be about 1000 feet in length or less than one-fifth of the requirement if all the tenants desired to use it at the same time. If moved in automobiles at the average rate of two persons per car this group of 13,200 persons would require 6,600 automobiles, or, at 30 foot centres, a string of automobiles 37.5 miles long. In a street 120 feet wide having roadway space for four moving lanes in each direction this number would occupy the entire capacity of one-half of the street for 9.4 miles.

When these conditions obtain, in-

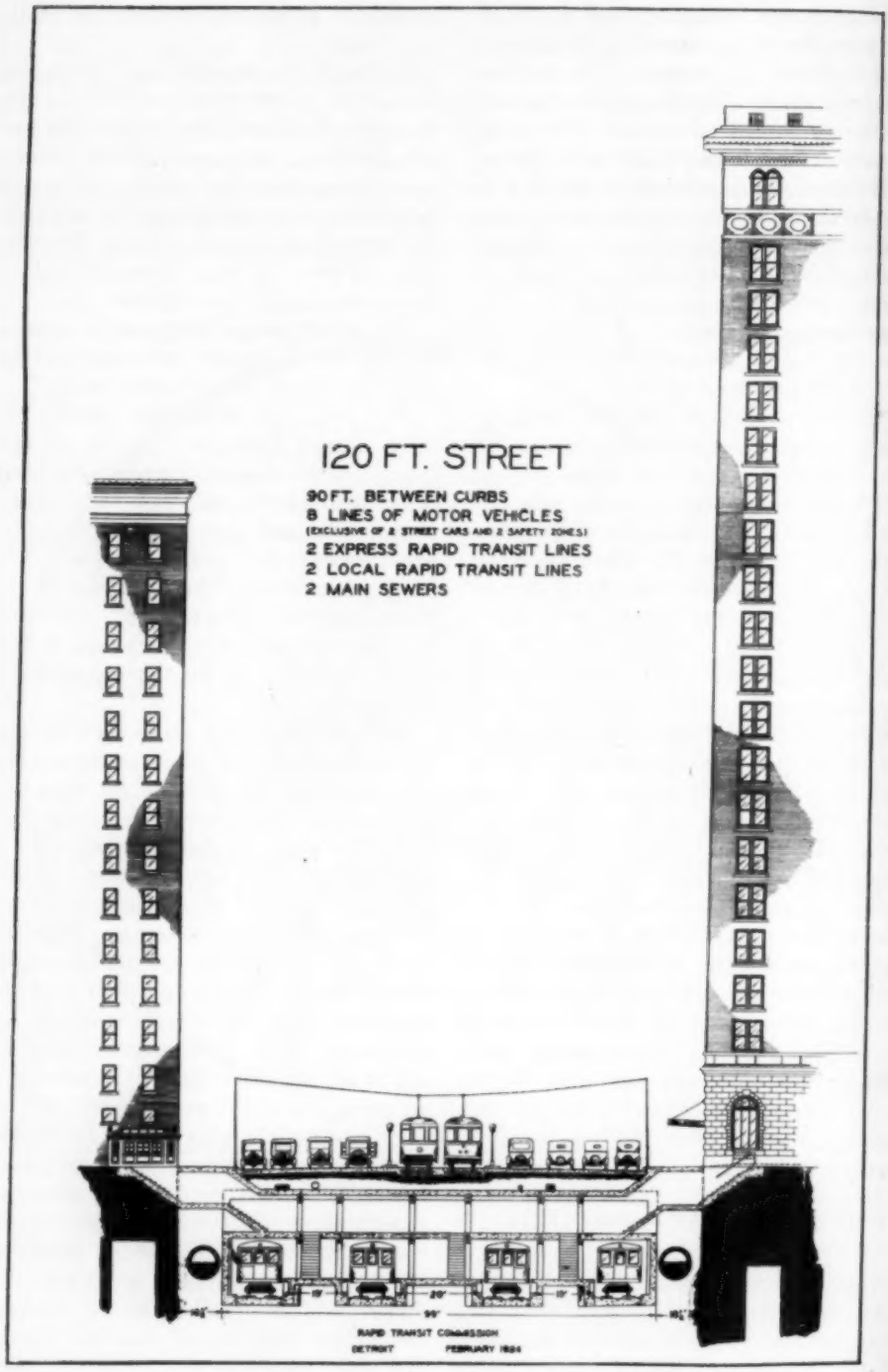

120 FT. STREET
90 FT. BETWEEN CURBS
8 LINES OF MOTOR VEHICLES
(EXCLUSIVE OF 2 STREET CARS AND 2 SAFETY ZONES)
2 EXPRESS RAPID TRANSIT LINES
2 LOCAL RAPID TRANSIT LINES
2 MAIN SEWERS
RAPID TRANSIT COMMISSION
DETROIT FEBRUARY 1924

FIGURE 2

dividual transportation must give way to some form of collective transportation. It may be well to consider the relative merits of the three forms of collective transit facilities, the bus, the street-car, and the rapid transit train.

From a performance standpoint, the relative value of the various forms of city transit has been the subject of careful study by the Rapid Transit Committee of the American Electric Railway Association. The following table presents the conclusions of this Committee.

On the basis of the foregoing table, a group of 13,200 persons occupying a single block of 30-story buildings could be moved

By automobiles	in 3 hrs. 13 minutes
By buses	in 1 hr. 48 minutes
By street cars	in 59 minutes
By local rapid transit trains	in 13 minutes
By express rapid transit trains	in 8 to 6.5 minutes

CAPACITY OF STREETS AND SUBWAYS FOR MAXIMUM HOUR[1]

100-Foot Street with Sidewalks 12 Feet Wide	Number of Vehicles	Number of Passengers
	For One Direction Only	
Automobiles Only		
Three moving lanes in each direction at 750 vehicles per hour One lane in each direction used partly for loading and unloading and partly for movement at 150 vehicles per hour	2,400	4,100
Automobiles and Buses		
One lane of Buses going to curb at intervals to receive and discharge passengers—thus displacing practically one and one-half lanes of automobiles. Two and one-half lanes of Automobiles at 600 per hour	1,500	2,550
One-half lanes of buses—230 buses—12,844 seats	230	7,305
Loading lane used in common by buses and automobiles		9,855
Automobiles and Street Cars		
One lane of street cars	150	13,500
Two free lanes of vehicles at 600 per hour		
One partial lane of vehicles at 150 per hour	1,350	2,300
		15,800
Subways		
Two track subways (one each direction) (1 direction)		60,000
Four track subways (two each direction) (1 direction)		100,000 to 120,000
Two track subway for surface cars (one each direction)		20,000
If street cars of such a street were removed and placed in a subway for street cars, the combined capacity of street surface and street cars in subways would be		24,100
Increase in capacity for automobiles on the surface		78%
Increase in passengers served above that on street used jointly	8,300	or 52.5%

[1] (From Report of Committee on Rapid Transit, American Electric Railway Association, October 8th, 1926.)
(Bus data from telegram J. W. Welsh, Executive Secretary, A. E. R. A., December 15, 1926.)

This indicates in a measure the burden that can readily be imposed upon transportation facilities at any time by a comparatively short period of high building construction, if concentrated within a small area; it further indicates the desirability of locating the transit routes so as to invoke a greater expansion of the central business area, rather than a greater concentration.

EFFECT OF TYPE OF STRUCTURE ON VALUES

Manifestly, where there is already insufficient room for existing street traffic, a new street, either overhead or underground must be created for rapid transit facilities.

The choice that is made here will have an important bearing on future property values.

A rail rapid transit facility, operating trains at high speed on an exclusive right of way has the same passenger carrying capacity whether the right of way be in an exclusive zone on the surface, on an elevated structure, or in an underground structure. In any case, the investment for permanent way and structures is an enduring investment. Because a rapid transit facility makes the property along its lines accessible to great numbers of people, it greatly enhances values and the potential benefit it confers on property is realizable in the degree that it is availed of by the property influenced. The routes selected and the type of structure may not be later changed without throwing away money, and the type of structure selected has an important bearing on the degree of enhancement in value of property along the thoroughfare occupied.

The distribution of the enhancement is directly affected by the type of structure. The maximum enhancement is along the line of the facility if located on the surface on a wide right of way, or if located in an underground structure. On an elevated structure in a street of ordinary width, the enhancement is less along the street occupied and greater along the first parallel street on either side, for the reason that the presence of an elevated structure deters the high class of development that takes place in a thoroughfare left unobstructed on the surface, and on which the rapid transit facility is permanently taken care of by being placed underground.

A further reason for the inferiority of the elevated in point of enhancement of values on the street it occupies lies in the fact that as cities expand in area and in density of traffic, the local service must be supplemented by express service and a four-track elevated structure in an ordinary business street would be practically out of the question. It would greatly depreciate the value of the street floor of buildings by shutting off light and air, and by the almost constant roar of the passing trains.

From the strictly dollars and cents standpoint the elevated structure is the cheaper, and if it can be built in a street 150 feet wide so that the reverberating effect of the passing trains is minimized and where the greater space affords opportunity to develop a permanent structure of architectural beauty, the final result in enhancement of property values might conceivably be comparable with the underground.

To obtain the necessary street width for this purpose, however, within the five-mile circle of a city of a million inhabitants, usually wipes out the differential between the cost of the elevated structure and the cost of the underground structure.

Summarizing the relative advantages it may be stated that a definite, positive, and immediate enhancement of property values is created by a rapid

transit line on the thoroughfare it occupies and in the territory it serves, whether the trains operate on surface on an exclusive right of way or in a depressed way, or on an elevated structure, or underground.

This special enhancement commences upon authorization of the project and continues through the construction period and after operation is instituted. Abundant records in New York, Chicago, and Philadelphia attest these facts. Equally well attested is the fact that in the case of an elevated structure the positive present enhancement is in a certain degree offset on the thoroughfare occupied by a negative value due to the lower type of development that takes place along the line of an elevated structure.

It would be wholly imprudent for a city to embark upon the construction of a two-track local service line without making provision for the right of way necessary for addition of express tracks. It would be equally imprudent to leave entirely to chance the selection of routes to be occupied by extensions and

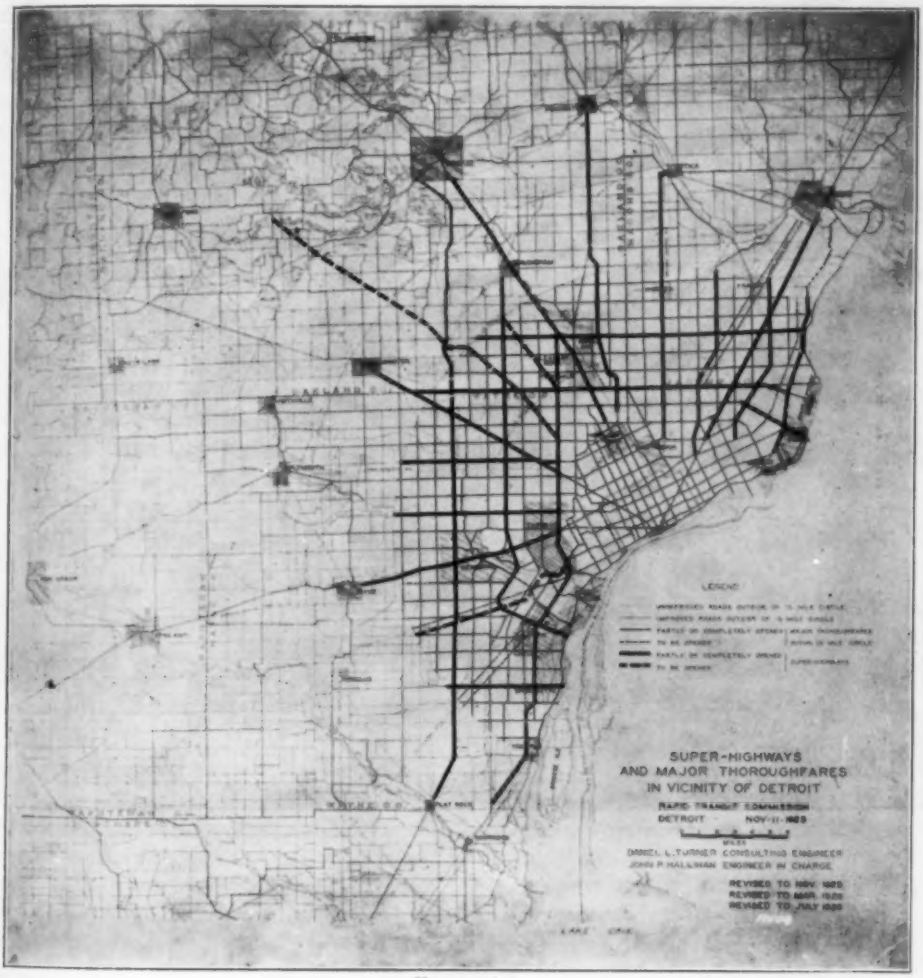


FIGURE 3

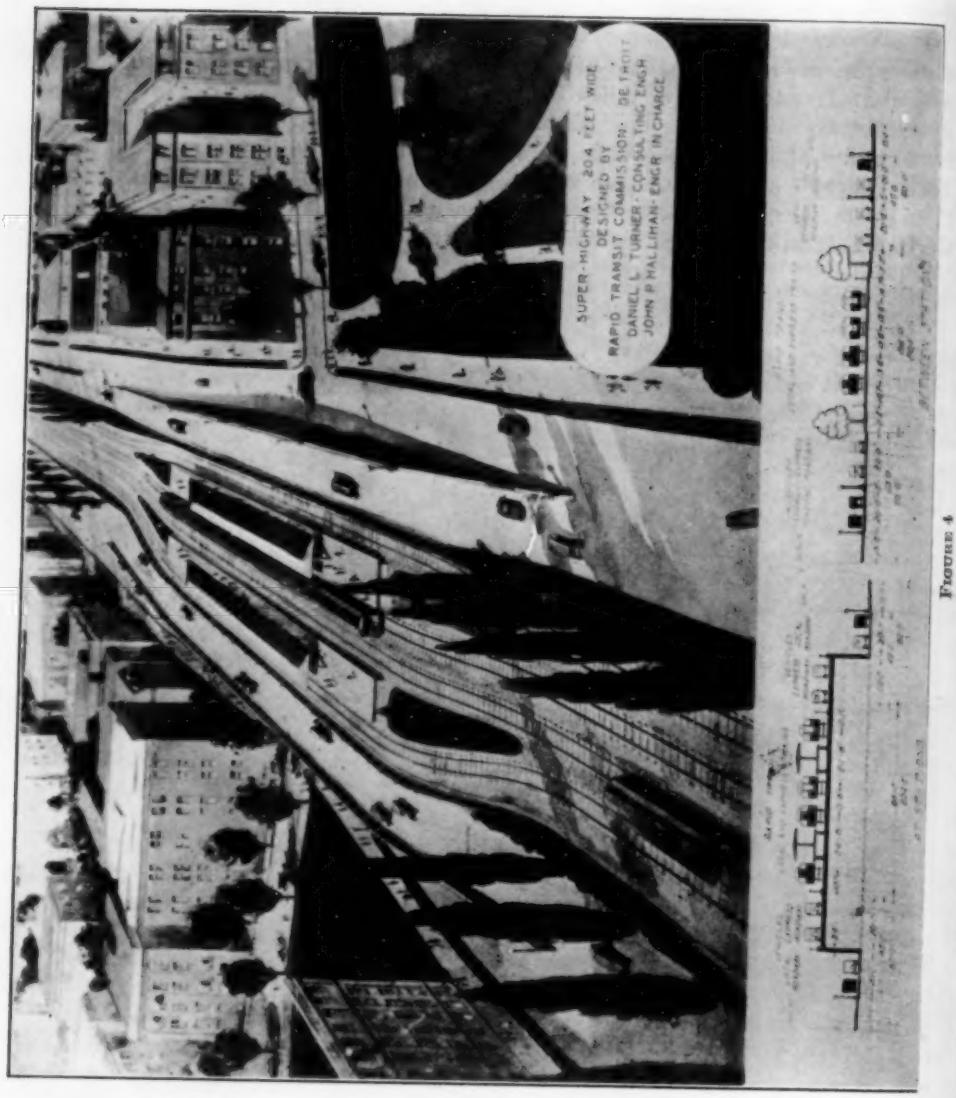

SUPER-HIGHWAY 204 FEET WIDE
DESIGNED BY
RAPID TRANSIT COMMISSION - DETROIT
DANIEL L. TURNER - CONSULTING ENGR.
JOHN P. HALLIHAN - ENGR. IN CHARGE

FIGURE 4

new lines. The more closely future development can be guided by a definite plan, the greater will be the construction economy.

It is necessary if the design is to be complete in an economic sense, to determine the economic width of two-level and one-level streets, to prepare a regional plan of routes, to set up the legal and administrative machinery to carry out the plan, and to start a program of accomplishment of the future plan that will proceed concurrently with the growth of the city in population and in harmony with its financial resources. This amounts to selling a vision of a future city to people whose immediate and pressing interest may lie in finding a place to park an automobile or in obtaining the privilege of straphanging in an overloaded street car.

STANDARDS OF WIDTH

It is not necessary to go into figures to prove to a motorist that driving is easier on a wide roadway than on a narrow roadway, but some investigation is required to determine the point where the cost of securing additional width overbalances the advantage gained.

Performance records in Detroit, on streets of various roadway widths, indicate rather clearly that the efficiency of a roadway per traffic lane rises rapidly from a roadway having a single moving traffic lane in each direction to a roadway having four such lanes, and thereafter remains fairly uniform. With the addition of a parking or loading lane, this means a roadway space of 45 feet in each direction and inclusive of 15-foot sidewalks, a width of 120 feet for the whole street between building lines. When occupancy by street car tracks, with accompanying safety zones reduces the free traffic lanes to two in each direction, the efficiency per traffic lane is still considerably better than in a narrower roadway with equivalent free traffic space.

Such a street, 120 feet between building lines, offers room underground for four tracks of a rapid transit structure with adequate loading platforms at stations, leaves room for local sewers, and minimizes underpinning of adjacent structures.

It therefore may be considered the desirable minimum width for an all-service major thoroughfare that must meet all the probable requirements of a large city.

Where this width is obtainable, and it generally is physically obtainable at reasonable cost in a city of a million people anywhere outside of the mile circle, it is false economy to adopt a lesser width, because reduction in traffic capacity, being measured in units of traffic lanes, proceeds at a more rapid rate than reduction in width of right of way. For example, an 80-foot street although it has two-thirds the width of a 120-foot street, has but one-half the traffic capacity, since, after deducting one-fourth of the width in each case for sidewalks, and deducting the parking lanes next the curb, there remain in the 80-foot street but two travel lanes in each direction while in the 120-foot street there remain four travel lanes in each direction.

The facilities carried on the two-level 120-foot thoroughfare in the built-up portion of the city may be carried on a single level at a greatly reduced cost. The rapid transit facilities, which, when placed underground require 120 feet for economical construction, can be put on the surface in an overall width of 84 feet and with the addition of the surface space of 120 feet for a 60-foot one-way street on each side of the central reservation, constitute a street 204 feet wide. The two-level street with a combined right

FIGURE 4

of way width, surface and underground of 240 feet thus becomes a single-level street with a right of way of 204 feet.

The standard width of country roads being 66 feet, it is necessary to acquire for the single-level street 138 feet additional right of way or 16.5 acres per mile. The cost of this additional right of way in the territory outside of the 5-mile circle rarely exceeds an average of $10,000 an acre or $165,000 per mile, an inconsequential figure in comparison with the differential of $2,500,000 between the cost of the permanent way of a two-track rapid transit facility underground and the cost of the permanent way for the same facility on surface.

This great potential saving points clearly to the wisdom and necessity of predetermining the routes and the design of the transportation streets of a large city, and in controlling their development so that local influences may not prevent realization of all the benefits intended to be acquired in the future.

This has been done in Detroit, where a comprehensive system of 204-foot superhighways has been laid out at approximately three-mile intervals in the territory between the 5-mile and 15-mile circles, supplemented by intermediate 120-foot roads at mile intervals, with a total mileage of 242 miles of superhighways and 421 miles of 120-foot roads. These are tied into a system of 120 ft. major thoroughfares within the more intensively developed section inside the 5-mile circle, so that the whole forms a regional plan covering the whole territory likely to be occupied by the city fifty years hence when it may reasonably expect to have a population of 5,000,000.

EXECUTION OF PLANS

Planning of this character in the comparative infancy of a large city is a community service of the highest order. The work of those engaged in it may be unappreciated and lack recognition for a time. It is a characteristic of human nature that people become restless and impatient when asked to consider the future, but the commonsense logic of making certain of the stability of the foundations before proceeding to erect any part of the superstructure makes itself apparent sooner or later.

It is a matter of record that in Detroit the Master Plan for the city of the future has been conceived, adopted by the city and counties and started on the road to accomplishment through the agency of bodies legally constituted under State legislation enacted to meet the needs of the plan, all within a period of three years, a moment's length in the life of a great city.

And while the city deliberates whether it will commence construction of the underground rapid transit lines within its built-up portion, the Super-highway Commissions are acquiring and securing dedications of right of way for the broad trunk lines and intermediate roads outside of the city, thus making certain that the extensions of the underground lines of the Rapid Transit System may be constructed on the surface on an exclusive right of way at a greatly reduced expenditure.

The progress in execution of the preparedness plans is indicative of what may be done by concerted effort of local authorities toward a definite objective in the interest of the whole region affected by the expansion of the principal city. It is encouraging to city planners who seek to maintain and utilize the freedom of individual transportation afforded by the automobile while providing in balanced measure for the unavoidable requirements of collective transportation.

The Relation of Tunnels and Bridges to Traffic Congestion

By Ole Singstad, C.E.
Chief Engineer of the Holland Tunnel

ANY treatment of the subject of traffic except in a general way necessarily restricts itself to a consideration of conditions in a given community because there are so many different factors which affect traffic. There are, however, certain fundamental principles, generally applicable, which must be given due consideration in proper planning to avoid traffic congestion. For the purpose of this discussion, particular attention will be given to the traffic conditions in the vicinity of the Holland Tunnel and the considerations which were given to the matter of eliminating traffic congestion in the planning of the tunnel.

The Holland Tunnel

The Holland Tunnel, constructed by the New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission, is designed for the accommodation of vehicular traffic. It connects respectively Twelfth and Fourteenth Streets, Jersey City, N. J., with the Borough of Manhattan, New York City, at Canal and Varick Streets and Broome Street, between Varick and Hudson Streets. The map, Figure 1, indicates the relative locations of the tunnel, upon the west side of Manhattan and the main arteries of cross-town traffic at this point, Canal Street, Broome and Delancey Streets leading directly to the Manhattan and Williamsburg Bridges, while the route to the Brooklyn Bridge may be followed from Canal Street southward, along Lafayette and Center Streets, to the bridge entrance near City Hall Park.

The tunnel consists of two separate tubes, the southern, to serve east-bound and the northern west-bound traffic. Figure 3, besides containing certain statistical information, shows the relative positions of the tubes to each other and something of their interior detailed arrangements.

The building of a bridge or a tunnel must be justified by the additional traffic facilities which it will afford and the resultant relief to existing unsatisfactory traffic conditions, and unless the structure is so planned that there will be no undue congestion at the bridge or tunnel terminals, the problem has not been satisfactorily solved.

General Traffic Conditions About New York

First a brief statement will be given of the general traffic conditions about New York.

Manhattan Island, somewhat over twelve miles long from its northern point at the Harlem River Ship Canal to the Battery, widens out to about two miles at its widest part in the vicinity of Fourteenth Street. It again narrows down to about one and one-half miles at Canal Street.

The following avenues comprise the more important highways of travel north and south: West Broadway and Fifth Avenue (this route forms a central artery of traffic flow); toward the east side of town, in lower Manhattan, Center and Lafayette Streets into

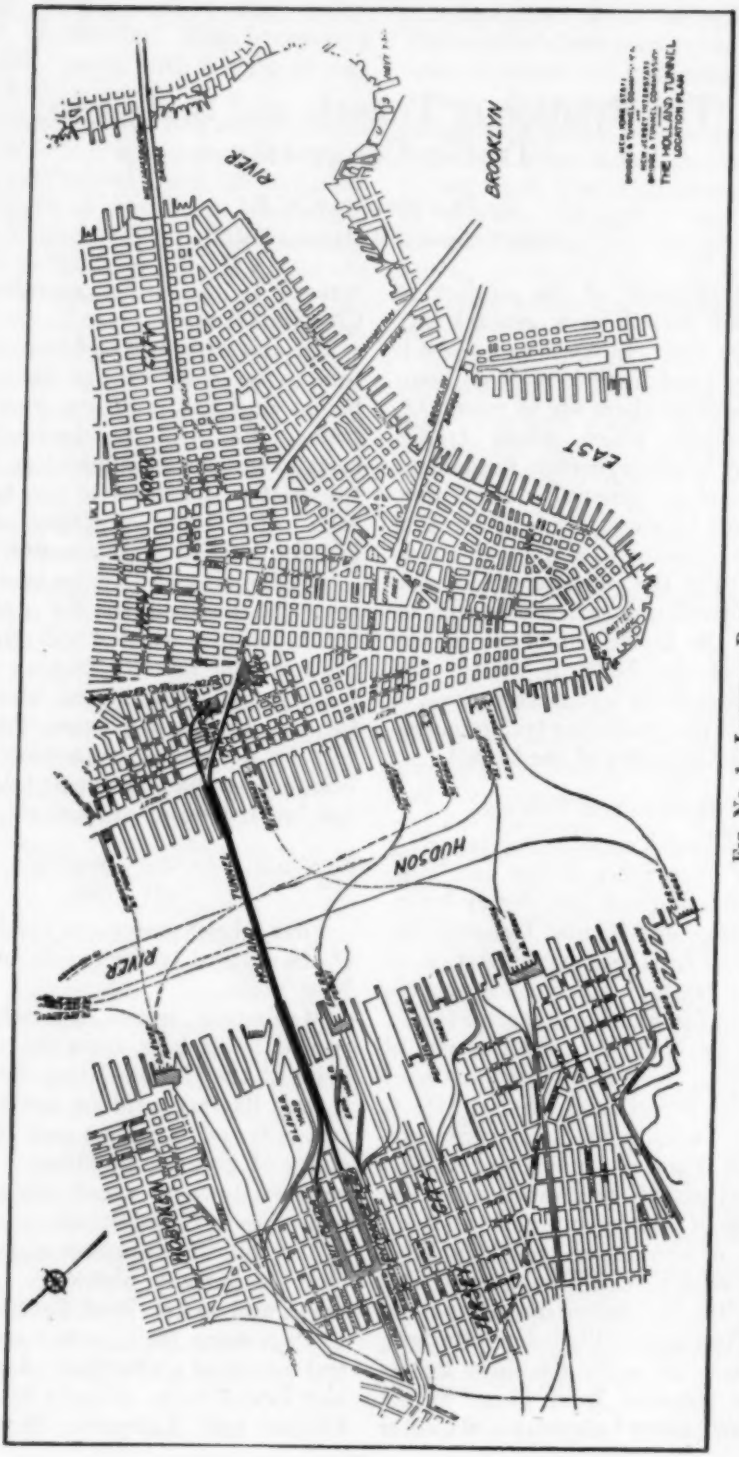


FIG. NO. 1—LOCATION PLAN

Fourth or Park Avenue, and further east, Allen Street and First Avenue; on the west side of town, West Street and Eleventh Avenue, Varick Street and Seventh Avenue and Hudson Street and Eighth Avenue, are the principal north and south thoroughfares. In the upper part of the west side, West End Avenue and Broadway, together with Riverside Drive (above Seventy-second Street) serve as such.

The main cross town streets in the lower half of Manhattan are Fifty-ninth Street, leading to the Queensboro Bridge across the East River, Forty-second Street, Thirty-fourth Street, Twenty-third Street and Fourteenth Street. Below Fourteenth Street are Broome, Grand, Kenmare and Delancey Streets, the last two at the entrance to the Williamsburg Bridge, while Desbrosses and Canal Streets give direct access from the west side of town and the Holland Tunnel portals to the Manhattan Bridge on the east side. Chambers and Barclay Streets in the region of City Hall Park conduct traffic cross town and to and from the Brooklyn Bridge.

Manhattan Island, the center of the business activities of the metropolitan district, is entirely surrounded by waterways which form natural barriers to the free flow of traffic to and from the island. The vehicular traffic between Manhattan and New Jersey is carried entirely by ferries, 15 in number, shown on Figure 2. Between Manhattan and the Boroughs of Brooklyn and Queens in Long Island, the traffic passes chiefly over the four East River bridges (the Brooklyn, Manhattan, Williamsburg and Queensboro), with a small percentage using the six ferries. The traffic to Staten Island (the Borough of Richmond) is conveyed by ferries and only to the north is there a continuation of the street system of Manhattan extending over a considerable number of bridges across the Harlem River to the Borough of the Bronx.

While it is true that the presence of these large bodies of water forming good natural harbors may be one of the principal causes of the greatness of the city of New York, still it is true that these waters act also as barriers preventing and often interrupting completely the free movement of vehicular and passenger traffic to and from the city. The several handlings now necessary in the subsequent distribution and transportation of freight in both directions by lighters, railroad floats, and trucks, the last named carrying it through the city streets and along the water fronts, contribute in large measure to the delay and ultimate cost of the freight at its final destination as well as to the street traffic congestion which now exists in the city.

Traffic counts made by the Department of Plant and Structures show that the four East River bridges on a typical weekday in 1926 handled 171,352 vehicles, while the six ferries crossing the East River handled an average of only 2400 vehicles per day, which is negligible compared to the traffic passing over the bridges. The vehicular traffic between Manhattan and Staten Island amounted to 2890 vehicles per day.

Fourteen of the ferries across the Hudson River, between Manhattan and New Jersey during the entire year 1926, handled an average weekday traffic of 37,594 vehicles based on figures collected by the staff of the Tunnel Commissions from the operating companies. The fifteenth ferry went into operation for the first time late in the year.

When it is borne in mind that on the Jersey side of the river are the terminals of eight trunk line railroads, that the greater part of the population

FIG. NO. 2—NEW JERSEY-MANHATTAN FERRIES

of the metropolitan district is located to the east of the Hudson River, that most of the steamship terminals, both for coastwise and foreign shipping, are located either in Manhattan or in Brooklyn, and also that there are large population centers in New Jersey immediately west of the river, it is quite evident that, when a comparison is made of the volume of traffic crossing the Hudson River with that crossing the East River, the absence of vehicular traffic facilities has been a great hindrance to the development and free

movement of the traffic between Manhattan and New Jersey. It was this pressing need for traffic facilities which prompted the two states to create the commissions which are now constructing the Holland Tunnel.

TWO TYPES OF THOROUGHFARES

In planning a bridge or a tunnel for vehicular traffic, particularly with reference to the elimination of undue traffic congestion, there are two types of traffic arteries which necessarily require different treatment: first, by-pass roads which will take through traffic around congested population centers rather than through them; and second, traffic thoroughfares which, of necessity, must go through the congested parts of the community. Traffic from points on Long Island or New England going to New Jersey should not be forced to go through the congested sections of Brooklyn, Lower Manhattan or Jersey City, but should be conducted over by-pass highways, either north of the traffic congestion in New York, or by connection between Long Island and Staten Island and by way of Staten Island to New Jersey. The river crossings for such highways could be made of very large capacity, as the approach roadways would be built through more or less undeveloped territory and adequate provision could be made for the handling of a large volume of traffic without undue congestion or excessive costs. With the other type of crossing, namely, between congested sections on either side of the waterway, one of the primary considerations in planning a bridge or a tunnel is not to concentrate so much traffic in one spot that intolerable traffic congestion will result. This was one of the governing considerations in planning the Holland Tunnel, which is to lead vehicular traffic across the Hudson River between the downtown section of Manhattan and Jersey City. The tunnel is located at the center of gravity of traffic over the ferries.

NUMBER OF TRAFFIC LINES FOR A TUNNEL

In planning the Holland Tunnel, consideration was given to roadways to accommodate one, two and three lines of traffic in each direction, and it was estimated that such roadways would have total hourly capacities in both directions as follows, based on all motor vehicles of truck and passenger car types: For one-line traffic, in each direction, total of 1260 per hour; two-line traffic, in each direction, total of 3800 per hour; three-line traffic, in each direction, total of 6040 per hour.

The roadway providing for one line of traffic in each direction was eliminated because its capacity would be inadequate to meet traffic requirements at the time of opening the tunnel, and the real question to be answered was whether the tunnel should be built with roadways for two lines in each direction or three lines. This consideration necessitated a thorough study of the traffic conditions on the streets in the vicinity of the tunnel, with a probable increase in the existing street traffic and the resultant congestion after the opening of the tunnel. The tunnel was planned so that the entrance and exit at either end were separated by at least two city blocks, thereby reducing materially the congestion which would have existed if both the exit and entrance traffic were concentrated at the same point. If one-half of the capacity of a tunnel, with three lines in each direction, were concentrated at the tunnel exit at Canal and Varick Streets where the normal street traffic at the time of the investigations were carried out, amounted to 1160 vehicles per hour, there would result a

FIG. NO. 3—PROFILE AND CROSS SECTION

total of 4180 vehicles per hour passing this point. This figure is without allowance for any part of the tunnel entrance traffic passing this point or for the normal growth of street traffic, both of which factors would add greatly to this number. A traffic count made at about the same time at Fifth Avenue and Forty-second Street, which is one of the city's busiest intersections, showed a total of 2269 vehicles passing this intersection during the maximum hour. This is only slightly more than one-half of the number of vehicles which would have been concentrated at Canal and Varick Streets with a three-line tunnel operated to its full capacity, and with no allowance for the increase in street traffic nor for the tunnel entrance traffic.

It should also be borne in mind that the roadway of a bridge or tunnel has a much larger traffic capacity than a corresponding roadway of a street, because there is no cross traffic interfering with the continuous movement of the traffic on a bridge or in a tunnel, while on the streets the cross traffic may interrupt the flow of the traffic 50 per cent of the time. It was therefore concluded that a tunnel should be built with roadways sufficient to accommodate two lines of traffic in each direction, with the entrances separated from the exits by two city blocks on either side of the river. Such tunnel would then accommodate all the vehicular traffic that could be fed to the tunnel or dispersed from the tunnel exit, without creating intolerable traffic congestion on the city streets in its immediate vicinity. Such congestion would seriously reduce the traffic through the tunnel below the maximum capacity of its roadway, or make it necessary to divert the flow of street traffic in the immediate vicinity, or both.

Recent traffic counts which have been made on the streets in the vicinity of the New York end of the tunnel show that the street traffic has increased to1600 vehicles per hour, passing the intersection of Canal and Varick Streets with a corresponding increase on the other streets in the same neighborhood. This confirms, even prior to the opening of the tunnel for public use, the correctness of the conclusions reached that a three-way tunnel in each direction could never be operated to its maximum capacity due to traffic congestion which would be created at the approaches, and that a tunnel with two lines of traffic in each direction will provide traffic capacity which will tax the adjoining streets to a point beyond which serious congestion will result.

In planning the tunnel plazas, consideration was given to the location of the entrance plazas, so as to provide access to the plaza from as many streets as possible and to provide sufficient area for the collection of tolls. The tunnel exit plazas have also been planned with a view to the rapid dispersion of the traffic into as many streets as practicable. The plans of these plazas are shown on Figures 4 and 5.

TUNNEL OR BRIDGE

In considering the economics of such a river crossing leading to a congested part of a city, it is quite evident that a tunnel is a more suitable and economic type of structure than a bridge, where the conditions are similar to those existing at the location of the Holland Tunnel, and, in fact, for entire Manhattan Island below Central Park. The waterway is over 3000 feet wide between the pierhead lines, the banks of the river are low, and the land values are high. If a bridge were to be built at this location, the cost would be excessive due to the long span, the expensive foundations due to the great

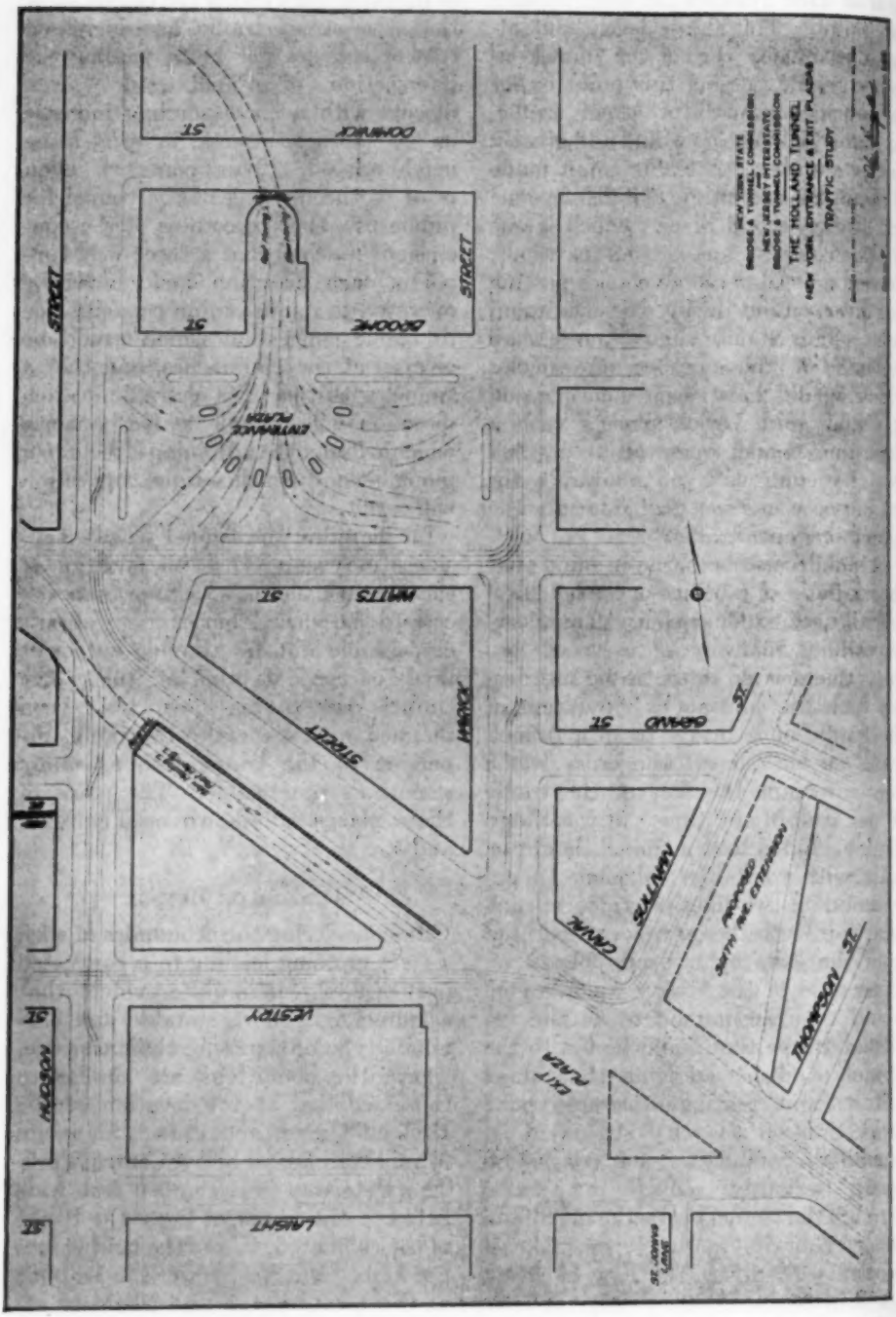


FIG. No. 4.—NEW YORK ENTRANCE AND EXIT PLAZAS

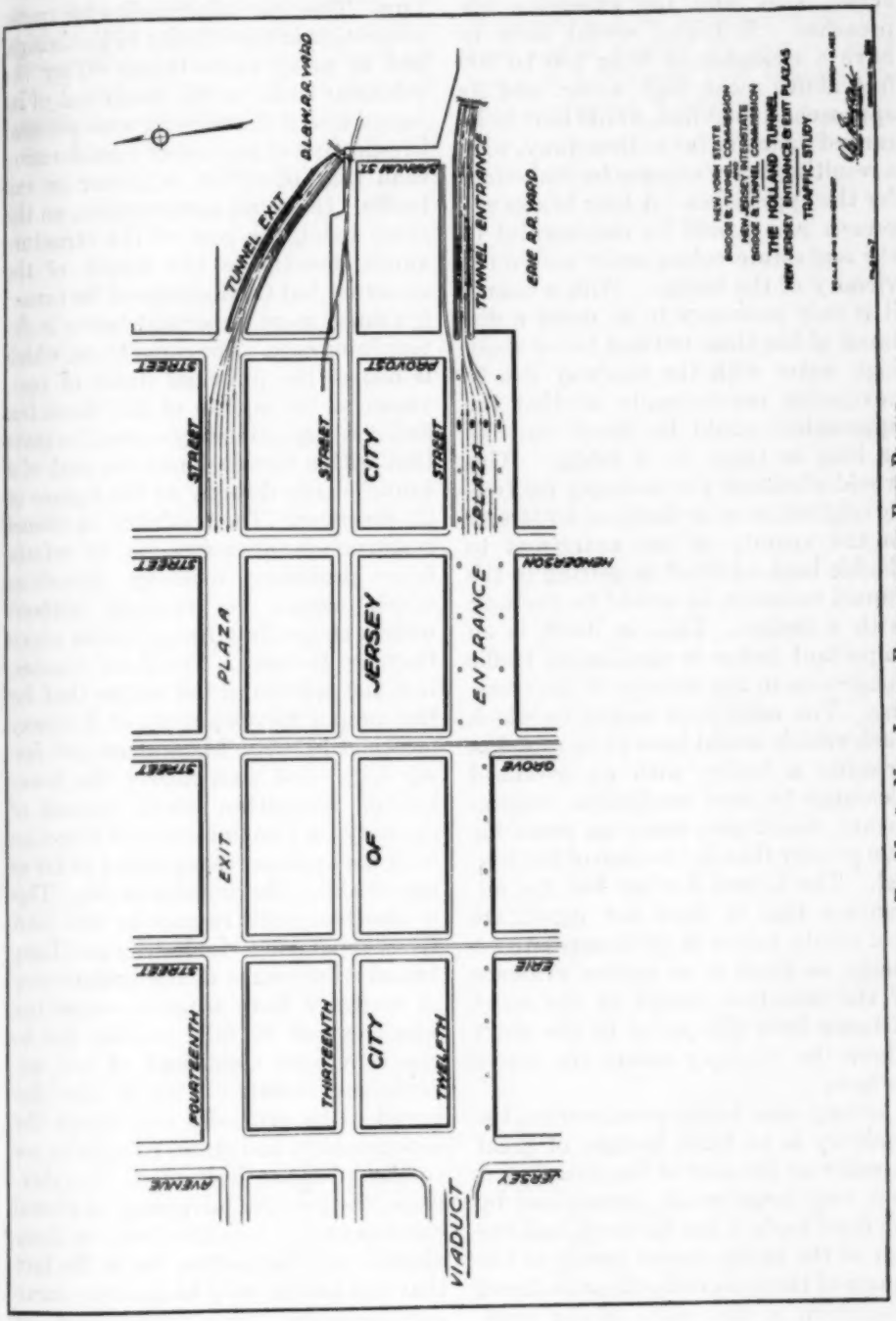


FIG. NO. 5—NEW JERSEY ENTRANCE AND EXIT PLAZAS

FIG. NO. 4—NEW YORK ENTRANCE AND EXIT PLAZAS

depth to rock, especially on the New Jersey side, and the expensive approaches. A bridge would have to have a clearance of from 180 to 200 feet above mean high water, and its approaches, therefore, would have to be carried inland as far as Broadway, with a resulting heavy expense for real estate for the approaches. A long bridge approach also would be detrimental to the real estate values under and in the vicinity of the bridge. With a tunnel it is only necessary to go down a distance of less than 100 feet below mean high water with the roadway due to navigation requirements, so that the approaches would be about one-half as long as those for a bridge. This would eliminate the necessity for traffic originating on or destined for streets in the vicinity of the waterfront to double back on itself in getting to the tunnel entrance, as would be the case with a bridge. This, in itself, is an important factor in eliminating traffic congestion in the vicinity of the crossing. The additional height to which each vehicle would have to be raised in crossing a bridge with an overhead clearance to meet navigation requirements, would also mean an economic loss greater than in the case of the tunnel. The tunnel further has the advantage that it does not depreciate real estate values in its immediate vicinity, as there is no surface evidence of the structure except in the short distance from the portal to the point where the roadway meets the street surface.

In long-span bridge construction, the tendency is to build bridges of great capacity as the cost of the structure is to a very large extent determined by the dead loads it has to carry, and the cost of the bridge varies nearly as the square of the span rather than in direct proportion to the width of the roadway. The tendency, therefore, is to provide a large roadway capacity as well as railroad facilities on the structure. This inevitably makes for traffic congestion in the vicinity of the bridge, and in many cases brings either the vehicular traffic or rail traffic out of its logical line, if the crossing were planned irrespective of any other consideration than that of either vehicular or rail traffic. In tunnel construction, on the other hand, the cost of the structure varies directly as the length of the structure, but the diameter of the tunnel is a much more important factor in determining cost. The excavation, which is one of the principal items of cost, varies as the square of the diameter, and it is approximately correct to state that within certain limits the cost of a tunnel varies directly as the square of its diameter. The tendency in tunnel construction, therefore, is to refrain from providing roadway capacities which cannot be reached without unduly congesting the territories which they are to serve. For these reasons, it is the opinion of the writer that for the proper development of highway crossings between Manhattan and Jersey City, and particularly the lower half of Manhattan Island, tunnels of capacity for two lines in each direction with the approaches separated as far as practicable is the proper solution. This is also true with respect to the East River separating Manhattan and Long Island where some of the bridges now in existence have roadway capacities which cannot be fully utilized due to the congested conditions of the approaching streets. This is also believed to be generally true where the topographical and street conditions are similar to those just cited. Furthermore, the peculiar advantage of tunnel construction in localities such as those about lower Manhattan lies in the fact that one tunnel may be built to serve the immediate future requirements of traffic, and later, when increased facilities are needed, a second tunnel may be

driven as near the first as is practicable. A development of this kind also permits the construction of smaller tunnels for rapid transit at locations which are selected as best, for this particular kind of traffic.

Likewise, where favorable topographical, geological, and locality conditions obtain for crossings of the first type noted, namely for by-pass highways, it is believed that bridges provide the proper solution.

Parking Facilities Outside the Traffic Zone

By Austin F. Macdonald
University of Pennsylvania

DURING the past few years many American cities have found it necessary to put into effect drastic regulations concerning the parking of vehicles within their congested, downtown business districts. These regulations have served to prevent the worst abuses of the parking privilege, but at the same time they have reduced materially the value of the private passenger car to its owner. An automobile is useful chiefly because it takes people *from* somewhere *to* somewhere; if it merely takes them *through* somewhere it has fulfilled but half its function. To keep traffic moving is a laudable aim; but motor cars must stop occasionally, else there is no point to their moving. The large majority of motorists visit the center of the city in order to conduct their business affairs, to shop, or to visit places of amusement. To most of them the privilege of using the streets of the business section means nothing unless they can find suitable parking facilities. Though some of the traffic on every city's downtown streets is undoubtedly through traffic, it is usually but a small percentage of the whole—or ought to be, for through traffic should be shunted away from the congested area.

Limiting the Motorist's Freedom

Forbidden the use of the streets without restriction for storage purposes, the average urban automobilist finds himself under the necessity of choosing one of three alternatives. First, he may leave his car at home and find some other less pleasant way of reaching his destination. This solution of the problem is receiving increasingly widespread acceptance. It has the indisputable advantage of reducing the number of vehicles on the road, but it has also the marked disadvantage of making large numbers of automobiles virtually useless to their owners most of the time. The second alternative of the city motorist is to find a suitable storage place near his destination. Private initiative has provided many such places. The problems of the downtown garage are treated at length elsewhere in this volume,[1] and need not be repeated here.

The city automobilist has still a third choice. In all probability he lives a considerable distance from the downtown area, and he may therefore drive his car to the rim of traffic congestion, park it in a convenient space, and make use of some other conveyance, probably the trolley, to complete his journey. Such an arrangement results in a minimum of wasted time and a maximum of comfort for the motorist; it also brings about a reduction of traffic congestion. Whether it will be used to any considerable extent in the future depends largely on the nature of the facilities provided at the outskirts of the traffic zone. As yet very little has been done to encourage automobile drivers to park outside the central business district. Most cities have directed their efforts instead to the negative task of discouraging motorists from entering the district. A few municipalities, however, have established parking spaces on city-owned property,

[1] See article by Hawley Simpson, Sept. *Annals*, 1927.

some of these spaces within the downtown area and some at its border. Pittsburgh provides facilities for nine hundred cars near the river's edge, and makes a daily charge of ten cents per car. In Akron the charge is twenty-five cents, while in Michigan City, Indiana, the twenty-five-cent fee is collected only on certain days when the traffic is likely to be heavy. Many cities provide free parking spaces. Usually no attempt is made to establish these parking facilities at points where they will be of greatest value to motorists and will serve best to relieve congestion. Their sites are determined instead by the chance location of vacant city land.

WHAT THE TRACTION COMPANIES ARE DOING

More significant is the experience of a number of street railway companies. These organizations are primarily interested, of course, in persuading motorists to use their facilities, and a number of them have hit upon the plan of providing ample parking space at their suburban terminals, making it an easy matter to transfer from the private to the public conveyance. "Park With Us And Ride With Us" is the slogan of the Philadelphia Rapid Transit Company, which has used the plan more extensively and with greater success than any other street railway operator. The Philadelphia company has established three large parking areas in different parts of the city along the rim of the traffic zone, and a fourth for special occasions near an open-air park. The three full-time spaces together accommodate 870 cars, but they are scarcely ever filled to capacity. During the summer months about 600 motorists daily make use of the traction company's parking facilities; in the winter the number is considerably less. The charge of twenty-five cents includes two carfare coins or "tokens," worth fifteen cents, so that the actual cost of parking is but ten cents. There is no time limit, but an additional fee is charged when an automobile remains more than twenty-four hours. Attendants are on duty most of the day and night, and at two of the parking places service facilities—gas, oil and the like—are provided.

Several other street railway companies have made similar experiments, though on a less extensive scale. The United Railways and Electric Company of Baltimore has a parking area designed to accommodate about 300 cars, and also charges twenty-five cents for parking and two street car rides. Unlike the Philadelphia utility, however, it does not control directly the parking and service facilities. Instead it leases the land to a private oil company, which operates the filling station and collects the parking fee. Watchmen are in attendance. The Boston Elevated Railway has a small parking space at the end of one of its terminals, likewise operated by an oil company under a rental agreement. The plan has also been tried in a number of other cities, though without marked success. In at least two, Pittsburgh and Poughkeepsie, it has been abandoned because of lack of patronage. The parking area on the outskirts of Fort Worth accommodates only 50 cars, and usually contains but 10 or 20. No charge is made, and no watchmen or service facilities are provided. The Chicago North Shore and Milwaukee Railroad, a steam road, has parking places at fifteen stations along its line, but the average number of cars which can be accommodated is only slightly more than 20, and watchmen are on duty at but one point.

In practically all cities parking spaces have been provided outside the traffic zone through private initiative.

Garages and filling stations at the edge of the congested area occasionally lease adjacent vacant lots for the purpose. In some cities the traction companies furnish garages situated near their lines with suitable display advertising suggesting to the passing motorist that he complete his journey to the center of town by trolley, leaving his automobile in good hands. The response of the motorist to the invitation is seldom hearty.

LITTLE HAS BEEN ACCOMPLISHED

From this hasty sketch it is clear that the establishment of parking spaces outside the congested area has not served, except in very small measure, to relieve the pressure on the center of the city. Automobilists have not made extensive use of the facilities provided. The Philadelphia Rapid Transit Company has been most successful, but it has succeeded in keeping only 600 cars a day out of Philadelphia traffic—assuming that all motorists using its parking areas would otherwise have driven downtown. And that is a bold assumption, for in all probability many would otherwise have kept their automobiles at home. Baltimore's traffic problems have not been materially lessened; the number of cars kept out of the downtown district certainly does not exceed 200 a day. The experience of other cities has been much the same; the Pittsburgh Railways Company gave the plan a trial of less than three weeks before discarding it.

It may be that the plan is inherently weak and that it cannot be made to appeal to automobile owners. Even though thousands of persons living in the suburbs of every large city drive to work daily in their motor cars, thereby adding materially to the traffic problem, it may be that they cannot be induced to park outside the traffic zone. But no such conclusion is warranted from the experiments thus far made. Nowhere has the plan been given a fair trial. In some cities parking sites have been selected without sufficient regard for the character of the surrounding territory intended to "feed" them. In others the undertaking has received little publicity, and a considerable portion of the motoring public has never fully understood the experiment. The parking fee has in several instances been too high.

WHAT MUST BE DONE

If car owners are to be persuaded to use other means of transportation within the congested area, they must be made to realize not only that they are helping to solve the traffic problem but also that they are receiving a valuable service at little or no cost. The parking fee should be very small—ten cents is suggested; or else it should be abolished entirely. Outlying parking places must be operated primarily for the purpose of relieving congestion and not of producing revenue if they are to be successful. The average motorist will not pay a large sum for the privilege of parking his car several miles from the center of the city when by paying only a little more he may drive to within a block or two of his destination and make use of the facilities of some centrally situated garage. The difference between the out-of-town and in-town parking charges should be considerably more than the price of two street car fares.

Because the rim-of-traffic parking places must be operated without much regard for the revenues they produce, most private capital is not likely to be attracted. The areas ought, therefore, to be in the hands of the city or of the local street railway company. The city has a vital interest, of course, in any plan that promises traffic relief; and the utility can afford to forego a direct profit because of the probability of increasing the number of car riders.

An added advantage of utility operation is the certainty that every parking place will be situated close to a trolley line and not in some less convenient spot.

The mistake has sometimes been made of establishing parking areas too far from the edge of traffic congestion. The motorist wishes to use his car until he reaches the point where heavy traffic and police regulations combine to make riding in a public conveyance both easier and quicker. Parking places several miles further out seldom tempt him.

Whenever possible the spaces should be covered so as to furnish some measure of protection against the elements. Attendants should be on duty at least eighteen hours a day. They increase materially the car owner's feeling of confidence, because their presence is obviously a protection against theft. Service facilities—gasoline, oil, tire repairing and the like—should be provided at every parking place. Under favorable conditions the profit from the sale of gasoline alone ought to be more than enough to pay the wages of the attendants and the rental of the land, if it has been leased.

One of the most important phases of the plan is ample publicity. The motorist should have the fact constantly hammered into his consciousness that it is no longer necessary to drive his car all the way into town, and that he can avoid trouble, delay, expense and the risk of accidents by parking on the rim of traffic and completing his journey via the street car. During the first month or six weeks after the opening of parking spaces it may be necessary to spend a considerable sum on advertising. This expenditure can readily be justified, because in all probability it will not have to be repeated. If the automobilist once forms the habit of using public conveyances in the congested area he is unlikely to return to his former mode of travel.

UNNECESSARY IN SMALLER CITIES

For the average city of fifty, or even one hundred thousand population, edge-of-traffic parking areas are scarcely necessary. The downtown district is comparatively small, and unlimited parking is usually permitted on nearby streets. Even within the central area a generous length of time is usually permitted for parking. One-hour and two-hour limits are common, and most drivers are able to complete their business within an hour. In a survey recently made in the business area of one city where the parking privilege was forty-five minutes, it was found that the average parking time was less than thirty minutes.[2] The traffic-rim parking space may be a partial remedy for extreme traffic congestion, but where such congestion does not exist the remedy need not be applied.

In the larger municipalities, however, the standing vehicle presents a most serious problem. Drastic parking regulations have been found necessary; some cities prohibit parking altogether during business hours, or during the hours of peak traffic. The congested district sprawls over a wider area, thus increasing the automobilist's troubles. Under such circumstances it would seem wise to experiment more widely than in the past with parking facilities outside the heavy traffic zone. These facilities, if properly operated and widely advertised, should make a strong appeal to the suburban motorist. And if the suburban motorist can be induced to keep his car out of the central business district, traffic congestion will be a far less serious matter.

[2] "Retail Store Problems," 1926 publication of the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, p. 118.

Downtown Storage Garages

By Hawley S. Simpson
Traffic Engineer, Essex County, New Jersey

THE rapidly increasing number of motor vehicles in the United States has brought to both rural and urban communities many problems which were unheard of and unthought of but a few years ago. No remedy or specific which is generally applicable and practicable in all cases has as yet been discovered, and it is doubtful if any will be. A contrary belief however appears to be held by the public, and the feeling is often expressed in the press that a panacea can be found which will immediately relieve, if not entirely solve all problems of congestion arising from continued and more intensive use of motor vehicles. The hoped-for solution is expected to benefit all and injure none. Such a condition is of course absurd. Traffic relief must necessarily come from a series of compromises, based upon a knowledge of all the essential facts, producing steady, if perhaps slow, progress toward betterment.

Not the least difficult to handle of the various problems is that commonly called the "parking evil." Parking is not an evil, but a necessity becoming an evil only through abuse of privilege. Terminals are necessary to the operation of a motor vehicle, generally furnished by the individual at his residence in "off street" space, but by custom and precedent—inherited from the day of the hitching post—provided in the business district by the municipality. Street space in business districts is required for movement of vehicles with allowance for a reasonable amount of "curb-terminal" space for short time shopping and business transactions only. Street space is too valuable when used in either of the above ways to allow any portion of it to be preëmpted for vehicle storage.

The value of the area occupied by a standing vehicle in the downtown district of Detroit, assuming that each square foot of pavement space has the same economic worth as the average value per square foot of land and buildings in the entire downtown district, is $6000. This investment can return a profit to the community only when used in the most efficient manner, and clearly, street storage of motor vehicles, benefiting only the individual at the expense of the municipality, is not efficiency.

Standing vehicles, generally called parked vehicles, are of three general classes, and it is essential that such a division be made, general definitions being as follows:

Loading Vehicle—A standing vehicle engaged in the process of expeditiously receiving or discharging passengers or merchandise.

Parked Vehicle—A vehicle (excepting loading vehicles) standing *not longer than a "reasonable period."*

Stored Vehicle—A vehicle (excepting loading vehicles) standing *longer than a "reasonable period."*

These definitions are of no value unless a "reasonable period" can be determined upon, which may vary considerably in length in different districts and is dependent upon the character of the business conducted in the area under consideration. In downtown districts devoted generally

to retail establishments, a determination of what constitutes a "reasonable period" has been made by the United States Department of Commerce,[1] arriving at conclusions based upon questionnaires sent to proprietors of all types of retail stores. The result of 195 replies from merchants in cities over 200,000 population is shown in Figure 1. The curve presents cumulatively the percentage of ordinary shop-

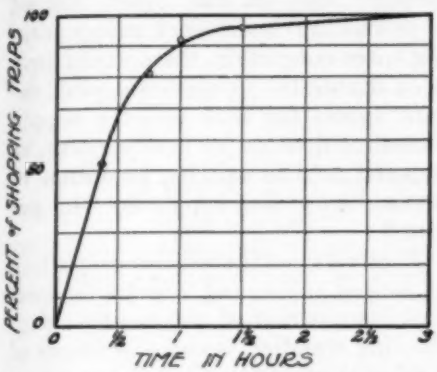


FIGURE 1.—PERCENTAGE OF SHOPPING PERIODS COMPLETED IN DIFFERENT LENGTHS OF TIME

ping periods which can be completed within any length of time. Ninety per cent of the average shopping periods can be completed in one hour, the curve rising rapidly to that point and slowly thereafter, fixing very definitely the length of a "reasonable period" as determining the dividing line between parked and stored vehicles. Any vehicle standing longer than one hour is stored and no municipality can afford to furnish free street storage in a business district to any class of motorist.

A distinction between parking and storing of vehicles was made as early as "1812 by the great jurist, Ellenborough, Lord Chief Justice of England. It was in the case of Rex *vs.* Cross, in which the defendant was indicted for allowing his coaches to remain an unreasonable time in the public street. The Court said: 'Every unauthorized obstruction of a highway to the annoyance of the king's subjects is a nuisance. The king's highway is not to be used as a stable yard'."[2] Such a differentiation as made at that time is more than ever essential under present conditions of traffic congestion.

EFFECT OF STREET STORAGE ON PARKING SPACE

Street storage of automobiles reduces the amount of parking space available for prospective shoppers and if eliminated, would materially increase the number of cars which can stop at the curb in the business district without adding any actual parking spaces. A survey recently conducted in Detroit covering the entire downtown business district illustrates the parking congestion arising from the usage of curb space for storing.

Figure 2 shows the number of vehicles standing for various lengths of time

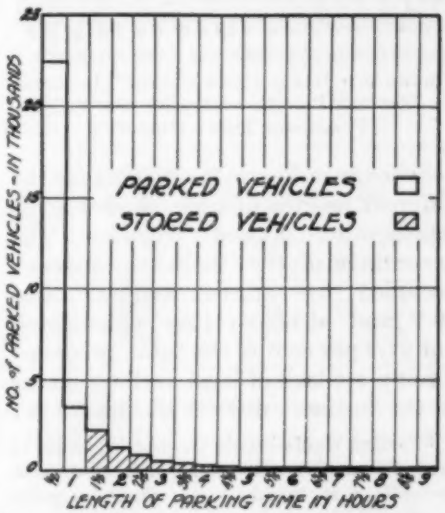


FIGURE 2.—NUMBER OF VEHICLES PARKED IN STREET FOR VARYING PERIODS OF TIME—DETROIT

[1] *Vehicular Congestion and Retail Business*, April, 1926.

[2] *The American City Magazine*, May, 1925, page 533.

in the downtown district.[3] The shaded area represents stored vehicles and is only a small proportion (21.9 per cent) of the total. The actual reduction in parking spaces occasioned by stored vehicles is measured not by the number of vehicles stored, but is a product of the number of vehicles multiplied by the length of time stored.

Figure 3 shows the number of "half-hour-spaces"[4] occupied by the same

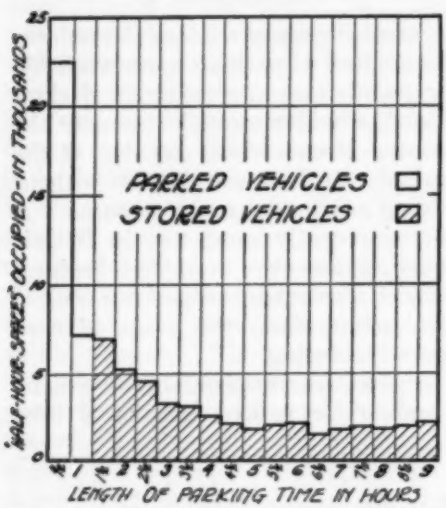


FIGURE 3.—"HALF-HOUR SPACES" OCCUPIED BY VEHICLES PARKED IN STREET FOR VARYING PERIODS OF TIME—DETROIT

vehicles as in Figure 2, standing for the different lengths of time, shaded areas representing stored vehicles. The percentage of the "half-hour spaces" occupied by stored vehicles was 60.3 and although they constituted but 21.9 per cent of the total, produced a complete lack of legal parking spaces in the business district during 83 per cent of the business day. During the period of maximum parking (1.30 to 2.00 P. M.), 1032 more vehicles were standing at the curb than there were allowable parking spaces. At this time standing cars exceeded parking space supply by 27.5 per cent, while 1908 vehicles or 39.8 per cent of the total were parked in violation of some parking regulation. If storing were entirely eliminated and only parked vehicles were on the street, instead of an existing condition of serious parking space congestion, there would have been during the maximum period, vacant spaces for 1851 vehicles, supply exceeding demand by 97.4 per cent, as opposed to the existing condition of demand exceeding supply by 27.5 per cent.[5]

Figure 4 gives the relative proportion of parked and stored vehicles for each half hour period of the business day, showing standing vehicles in excess of legal parking spaces during seven and one half of the nine hours; due entirely to the presence of stored vehicles, even though the number of these vehicles was an inconsiderable proportion of the whole.

Street storage not only produces an artificial shortage of curb space, but adds unnecessary street traffic by owner driven vehicles cruising in search of a place to stop, and by chauffeur driven vehicles which find it convenient and sometimes necessary to "cruise" in the neighborhood in which the owner is transacting business. A sort of "mobile" parking thus arises in that portion of the street which should be devoted to moving traffic. In the

[3] Parking regulations in the district surveyed are as follows: No parking, 7.30 A. M. to 9.15 A. M. and 4.30 P. M. to 6.15 P. M. One-hour parking from 9.15 A. M. to 4.30 P. M. Parking prohibited at all times at 64.2 per cent of the curb space in the business district.

[4] A "half-hour-space" is a space occupied by a vehicle for one half hour. A vehicle stored four hours occupies eight "half-hour-spaces."

[5] The survey showed the following:

	Hours	Minutes
Average parking time.....	0	34
Average storing time.....	3	4
Total average time at curb ..	1	7

One stored vehicle occupied approximately six times as many "half-hour spaces" as one parked vehicle.

FIGURE 4.—DISTRIBUTION OF VEHICLES PARKED IN STREET, SHOWING NUMBER OF VEHICLES PARKED AND STORED AT DIFFERENT HOURS THROUGHOUT DAY—DETROIT

survey in Detroit, tallies were made to determine the extent to which "mobile" parking was indulged in and the results obtained at two locations in the retail district are summarized in Table I.

TABLE I—VOLUME OF CRUISING EMPTY PRIVATE AUTOMOBILES IN RETAIL DISTRICT, DETROIT, BETWEEN HOURS OF 2 P. M. AND 6 P. M.

	No. of Cruising Empty Private Automobiles	No. of Trips Passing Same Point	Average Trips per Vehicle	Maximum Trips per Vehicle	Per cent of Total Traffic
First Location	76	360	4.73	24	19.3
Second Location	188	689	3.66	17	34.4

These conditions, while perhaps not exactly typical of other cities, are indicative of the bad effects of usage of curb space for "storing" and force the conviction that street storage must be eliminated. If the stored vehicle is to be removed or legislated from the street, it is patent that sufficient storage space must be provided "off street" in parking garages (or lots), which are so attractive that motorists will rather store within them than in the street. An alternate solution might be to provide mass transportation service on a par in speed, comfort, and convenience with the private automobile, so that the private car would not be as generally used in the downtown district, but such a discussion has no place here.

GARAGE LOCATION AND TYPE OF CONSTRUCTION

Storage garage enterprises have not always been successful, and failures have perhaps tended to retard construction. The need for storage service is so great that every effort should be exerted previous to beginning a project to assure profitable operation, and it may be safely stated that two major factors: (1) location, and (2) type of construction contribute largely to the success or failure of garage operation.

In deciding upon the general location of a storage garage, consideration must be given to many different elements which enter into the degree of service which will be rendered the public and which will be measured by the return realized on the investment. Any location, merely because it is within the congested district may not support a paying garage. Some well-constructed and well-managed storage garages operate at a loss, while others no better in these respects are very profitable

investments, the extreme probably being in a certain storage garage which it is said returns 90 per cent yearly.

An analysis of the downtown district of Detroit was made in connection with the question of additional garage construction. Detroit's business district is divided quite distinctly into an east and west side by Woodward Avenue with quite different use characteristics and a preliminary study was made to determine upon which side of Woodward Avenue there existed the greater potential demand for a storage garage. A summary of a portion of this study is given in Table II.

TABLE II—STATISTICS SHOWING RELATIVE VALUE OF WEST SIDE AND EAST SIDE BUSINESS DISTRICT FOR STORAGE GARAGE PURPOSES, DETROIT

	West Side	East Side	West Side as Percentage of East Side
1. Assessed valuation per sq. ft.	$48.58	$31.20	155.7
2. Cars entering district per unit of area	0.264	0.166	159.2
3. Parking turnover in street per available parking space per day	11.42	7.48	152.6
4. Average instantaneous number of vehicles in "off-street" space per unit of area in district	.001344	.000754	178.1
5. Number of "off-street" parking spaces per unit of area in district	.001855	.001358	136.6

Items 1 and 2 are indicative of the relative existing building bulk and vehicular volume, both producing congestion, and congestion producing business for the storage garage. Items 3 and 4 indicate a greater usage of parking space, both street and "off-street," on the west side than on the east side very nearly in the same proportion as shown by the assessed valuation and traffic volume, and it can be assumed that if the two districts are to be on a parity as regards "off-street" storage facilities, the west side should have about 160 per cent of the east side capacity in proportion to the area. The existing figure (136.6 per cent) is somewhat lower and additional garage facilities should be established first on the west side, but an analysis as to whether such service is immediately required demands further study. The foregoing is cited as an example of certain ways in which to attack the problem, and studies of this sort are essential if the greatest value is to be derived from the storage garage.

The existing and probable future parking habits of different classes of motorists to which a garage may cater are important in deciding upon a more specific location. Garages may serve employees in retail stores and offices, persons with business, social or theater engagements in the downtown district, and tourists, to mention only general classifications, and these classes exhibit distinctly different habits of which a knowledge is essential. As an example, the habits of 217,621 persons entering the downtown district of Detroit are classified in Table III.

CONSTRUCTION

The essential choice in type of construction in multi-floor garages lies between the different means of providing inter-floor travel, as between elevators or ramps of different types. The type selected should provide maximum

TABLE III—EXISTING STORAGE HABITS OF MOTORISTS—DETROIT

	Percentage of Persons Entering Business District Who Drive Automobiles	Percentage of Motorists Parking in "Off-Street" Space
Employees in		
Retail stores	4.57	73.27
Office buildings	20.94	87.68
Customers of		
All retail stores	19.1	45.5
Exclusive shops	35.4	47.2
Average price stores	19.6	46.9
Popular price stores	15.2	37.5

facility of ingress and egress, maximum safety, and absolute freedom from interruption of service.

Probably the most satisfactory, economical and generally used type of inter-floor travel makes use of a patented system of staggered floors with short ramps of easy grades, and provides for rapid vehicle movements with safety. Garages up to eight floors in height have been erected with these type of ramps, and motorists experience no difficulty in making a complete ascent or descent, although in some garages only employees drive on the ramps.

INCREASE OF GARAGE USAGE

Lack of capacity use of garages is due to the general scale of prices for storage, and little further relief from street storage can be expected until storage garages can be operated at lower rates. Modern garages charging up to $20.00 per month for storage can not be patronized by all of the employed persons in a business district who have occasion to use motor vehicles in going to and from work. Centrally located garages are the rule with the high land value contributing materially to high storage rates. Utilization of rear lot space with arcade entrances through an office or shop building, and where possible, the construction of a garage in the central well of office buildings will assist in bringing about lower rates. A twenty-two story garage handling 572 cars built in what would have been the light court is now in operation in the new Jewelers Building in Chicago and is an example of what may be done in other structures.

Construction of garages in a belt circling the business district, in that section which is in a state of transition between residential and business use and of relatively low value, would serve two ends, making possible lower rates and keeping vehicles from the central district, but lack of means of rapid transportation between garage and office would lessen their use by increasing the time element, thus negativing one of the advantages of private transportation. Deluxe buses, operating on a short headway over definite routes, would very probably overcome this objection and should prove successful. Such service would appeal to the woman shopper and be much less expensive than the plan in which the car is driven and redriven between store and garage by a garage employee. Coöperation of garage interests with office building and retail store managements might develop outlying garages catering almost solely to a certain definite group of structures, resulting

in a stabilization in demand. Serious consideration is being given to such a plan by one of the largest operators of storage garages in the country.

Construction of sub-surface garages in park areas can aid in reducing charges by eliminating land cost. A proposal has been made for the construction of such a garage in Bryant Park in New York and other cities have similar ideas. The recent traffic survey made in Chicago proposed the construction of an underground garage in Grant Park using the area now given over to an open air parking space.

Private capital should be given every encouragement to establish storage garages, and cities should refrain from entering a field in which there appears no logical reasons for municipal operation. Even operation of sub-surface garages under public property is not necessarily a municipal function, and private operation with its greater potential economies, will better serve the public good.

The municipality could lease space below park areas for garage purposes for a consideration only sufficient to legalize the transaction, with the proviso that a specified type of garage be built, the entire structure to revert to the city after the investment is amortized and a certain profit realized, to be then re-leased to the highest bidder. Control of operation and rates might be left in the hands of a municipal board. This plan could be extended to include vehicle storage space under boulevarded and other wide streets.

NON-PROFIT STORAGE

Recently many downtown stores have undertaken to provide storage for customers' vehicles while shopping, either at a much reduced rate or at no cost to the shopper, in a garage solely or coöperatively owned, or in a public garage by previous arrangement. It would appear that such concerns should be commended for attempting to help in the solution of a troublesome problem, but further consideration forces the belief that such efforts are not well directed. Storage furnished free to the shopper increases cost of merchandising and is eventually met by the shopper. Free service of this sort is not essentially a function of merchandising and is no more necessary than for a merchant to store busses or street cars of the railway company in an attempt to reduce cost of transportation. And rather than assisting in solving the street traffic problem it may very probably have the opposite effect by inducing a large amount of unnecessary vehicle usage. Free storage is an economic fallacy readily realized if consideration were given to the law of the conservation of energy.

Camouflaging the cost of private transportation may be successful at first or may succeed as an advertising stunt, but a very serious precedent is established which may in the future prove burdensome and experience has shown that when begun by one merchant is soon instituted by others in self protection and for the same reason must be continued ad infinitum by the original merchant. The public believing it is receiving something for nothing is inclined to revolt against paying regular garage storage charges in the business district when not on a shopping tour. Free storage of any sort severely limits legitimate storage garages and mitigates against their fullest use. Motorists must be educated that if they desire the advantages of private transportation they must meet all its obligations. Parking space is being reduced in every city in the interest of movement space; stopping times are being instituted, complete prohibitions either during all or part of the day are becoming more common, and park-

ing and storage must be increasingly furnished in garage space, not in the street. The sooner this realization becomes general the sooner permanent relief will be realized.

Office building owners sense the coming change and are either providing space for the vehicles of tenants and their clients in new construction, or by contract with an existing garage, guaranteeing a certain minimum area usage at a bulk rate, the saving being returned to the tenant. This service is not given free to tenants as is the case in retail stores, but is borne entirely by the tenant. A certain large office building finding rentals slow announced the construction of an addition, combining a nine-story ramp type storage garage. Although the structure will not be completed for more than a year, much space in the new building is on option, and this in the face of slow rentals in existing buildings without garage space available.

CONCLUSION

"Off-street" storage space is essential to the efficient use of city streets, since street storage contributes quite materially to congestion in both parking and movement spaces. With but few exceptions existing storage garages even in centers of extreme congestion are not being used to capacity; not because the public does not desire the service, but rather because the service available is beyond reach of their purse. Increased use will result with lowered charges, and lower charges are dependent upon lower cost of construction and lower land value. Means to secure lower costs are available and encouragement should be offered to private capital to increase the storage capacity available to persons of moderate income. Probably the most fertile, but by no means the only field, is in construction of sub-surface garages under public property. Free storage offered to shoppers by merchandising interests is an economic error and acts as a boomerang not only to the merchant, but to regular storage garage enterprises.

It must not be expected that abolition of street storage and parking accomplished by complete use of "off-street" space will solve the traffic problem. But it is one angle of attack, and progressive solutions of portions of the entire problem point the way not perhaps to a complete solution, but to certain betterment of congestion ills.

Traffic Control

By Burton W. Marsh
Traffic Engineer, Department of Public Safety, Pittsburgh

DESPITE the fact that a considerable proportion of traffic signals are now generally regarded with disfavor, it is probable that in the not distant future traffic in the business districts of large cities and on main arteries will be enabled to move continuously in an orderly fashion at definite, regulated speeds by electric traffic control systems of the "progressive" or "continuous" movement type. Through-movement under such control will approach in orderliness and positiveness the control of trains on main lines and in important terminals.

This paper traces the functional development of both manual and automatic "stop-and-go" traffic control.

Historical Development of Traffic Control

Up until 1900 police gave attention to traffic only when there were parades, disputes between drivers, vehicles blocking the highway, or in order to assist children and the infirm across the street.

Officers were probably first assigned to traffic duty in 1903, in New York City. At first the officers were mounted and did not have duty at a single fixed post. Attention was soon directed to intersections, however, as most troubles occurred there. Officers stationed at important intersections developed crude hand motions to slow up, stop, or move traffic, as was necessary. As traffic grew, it became necessary for the officer to stop traffic on each street in turn to give traffic on the other street the opportunity to move. Thus began what is now popularly called "stop-and-go" traffic control.

Arm signals, body positions, and whistle signals were gradually developed and to some extent standardized in each city. Then came the well-known hand semaphore to aid the traffic officer. The semaphore had the advantage of giving a positive, unmistakable signal visible over other vehicles. Stands and even towers were developed in connection with semaphores, mainly to give the officer a clearer view in all directions.

Experiments to inter-relate the movement of traffic at various intersections along an artery took place as early as 1912 in New York City. The plan was to have all traffic move along the main artery at the same time and then to stop so as to permit traffic on all side streets to cross the artery simultaneously. These early experiments were made with the use of signal flags and hand-operated semaphores.

As traffic grew, traffic officers became more skilled in their work.

In 1920, there were about nine and a quarter million automobiles registered in this country. In 1926, the figure was about twenty-two million. Especially during this period of tremendous increase in traffic, there have developed in cities a considerable number of truly expert traffic officers. Surprising skill is shown by the best officers in handling complicated traffic situations at the busiest intersections.

Whistle and arm signals have been standardized, parking, loading, and many other important rules governing street use have been made, and many

other phases of traffic work are effectively handled by the best traffic officers.

ADVANTAGES OF CONTROL BY TRAFFIC OFFICERS

A competent traffic officer working at his best can usually handle traffic at an individual right-angle corner better than any other means of control of *that individual corner* yet developed. The officer can take advantage of variations in the volume of traffic on the two streets and give to each street that proportion of time best suited to it *at that minute*. He can often take care of street cars, loaded and ready to go, in a way which no mechanical device could do. He can aid turning traffic, especially that which is turning left—often being able to "weave" it through the traffic from the opposite direction without entirely stopping either line. He can control any unusual condition or emergency. In brief, while working at his best he can use brain power for the best handling of traffic at that corner, and brain power efficiently used is, of course, usually better than mechanical control for a single corner. There is a limit, however, to the number of factors an officer can handle efficiently. The advantages of officer control diminish at the more complicated intersections as the number, volume, and regularity of different kinds of movements increase.

DISADVANTAGES OF CONTROL BY TRAFFIC OFFICERS

There are, however, important limitations and disadvantages to control by a traffic officer. Some of the most important of these are as follows:

1. *Coördination.* It is impossible for an officer to coördinate his work with the efforts of officers on all four sides of him one block away. This limitation can be quickly grasped if one will imagine all four officers at intersections surrounding the one in question, releasing a stream of traffic at such a time that all four streams arrive at the corner in question at the same time. The accompanying cartoon (Fig. 1) aids in illustrating this limitation. The importance of this inability to coördinate officer's efforts throughout a business district or along an artery, is tremendous. Impossibility of coördination is the *main* reason why a proper electrical traffic control *system* can, if conditions are favorable, usually handle traffic in an important business district more expeditiously and efficiently than can even first-class officers working as isolated individuals.

2. The officer is often difficult to locate quickly. Hence, a loss results in obedience to his signals and in free movement. If the officer is raised well above the street surface, this disadvantage is partially eliminated, but in this case another disadvantage is introduced in that the officer can no longer aid in "weaving" traffic, in untangling snarls, etc.

3. If the officer uses a semaphore, there is an unfortunate tendency for him to become merely a human machine to turn the semaphore. Here again there results the loss of his service as regards "weaving," etc.

4. The traffic officer is the natural "information bureau." He must courteously answer literally hundreds of questions per day. This means the diverting of his attention from his main duty of efficiently dispatching traffic.

5. Unfortunately the officer must also be at least civil in answering lengthy greetings of well-meaning but thoughtless citizens. Some officers initiate conversations themselves. The importance of such diverting influence is considerable.

6. Aside from his main duty of dis-

HEY BILL! TAKE CARE OF THIS TRAFFIC - WILL YOU?
WAIT STOP
TRANSFER
CLANG!
CLANG!
HONK
HONK!
HOW CAN I KEEP ALL TRAFFIC MOVING WHEN IT GETS HERE FROM ALL FOUR DIRECTIONS AT ONCE!
STOP
STOP
HONK
HONK

PICTURE 1

patching traffic, the cornerman must also at times be the law enforcement officer. It is sometimes necessary to reprove, sometimes to "tag," and occasionally to arrest flagrant offenders. While the officer is engaged in such duties, unless the corner be double-manned, traffic is entirely without supervision and control.

7. In case of fire, accident, or other emergency, the traffic cornerman must frequently leave his post uncontrolled for considerable periods of time.

8. When for any reason new traffic officers assume any important post, time is required before they learn to operate the corner most efficiently. The length of this period is not great, however, when (as customarily) experienced, skillful officers are substituted.

9. Of course an inefficient officer, or any officer working inefficiently, is a very serious disadvantage.

10. Last, but by no means least, is the item of cost. As a matter of fact, perhaps the most important consideration which has led cities to go to control by automatic signals, has been the staggering burden of continually adding traffic officers for eight-hour duty to take care of the fast-increasing number of corners demanding "stop-and-go" control.

HISTORICAL DEVELOPMENT OF ELECTRIC "STOP-AND-GO" SIGNAL DEVICES

After "stop-and-go" traffic control by cornermen came to be seen as an important field and one which was bound to develop, experimentive and inventive individuals and various companies, saw the possibilities of traffic control by electric signaling devices. The development and success of railroad signals doubtless played a part in the early efforts toward development of traffic control signals.

About 1910 the development of electric traffic control signals commenced. A new field was then started, the importance of which to traffic control of the future, is not fully appreciated by many persons today.

The earliest installations of which record has been found, were naturally for the control of one particular corner. They were designed for manual control by an officer stationed at the corner. The *American City* magazine of September, 1915, has a record of one of the earliest pioneer electric traffic signals. It was erected in Cleveland at the intersection of Euclid Avenue and East 105th Street on August 5, 1914. At the time that article was written, the signal was still in operation. San Francisco and Salt Lake City installed signals in 1915 and 1916 respectively.

Baltimore tried out, for a short time, a "Painter Traffic Signal" in 1916. Indications are that the signal was given up because it was so popular that it was felt that increasing demand would call for the use of too much city money. New York City had a kind of electric traffic signal installed on the original wooden towers on Fifth Avenue in 1918, while Detroit and Philadelphia are also known to have been pioneers in the installation of electric traffic signals.

GROWTH OF THE ELECTRIC TRAFFIC SIGNAL FIELD

The real commercial development and sale of electric traffic signals began in a very small way about 1921. The accompanying graph (Fig. 2) indicates, in a rough way, that the development was very slow until 1923 or 1924. Since that date there has been, as the chart indicates, a rapid development in this new field. The total number of signals installed in the United States to date is, however, not large—the figure for 1926 having been roughly estimated at approximately eight

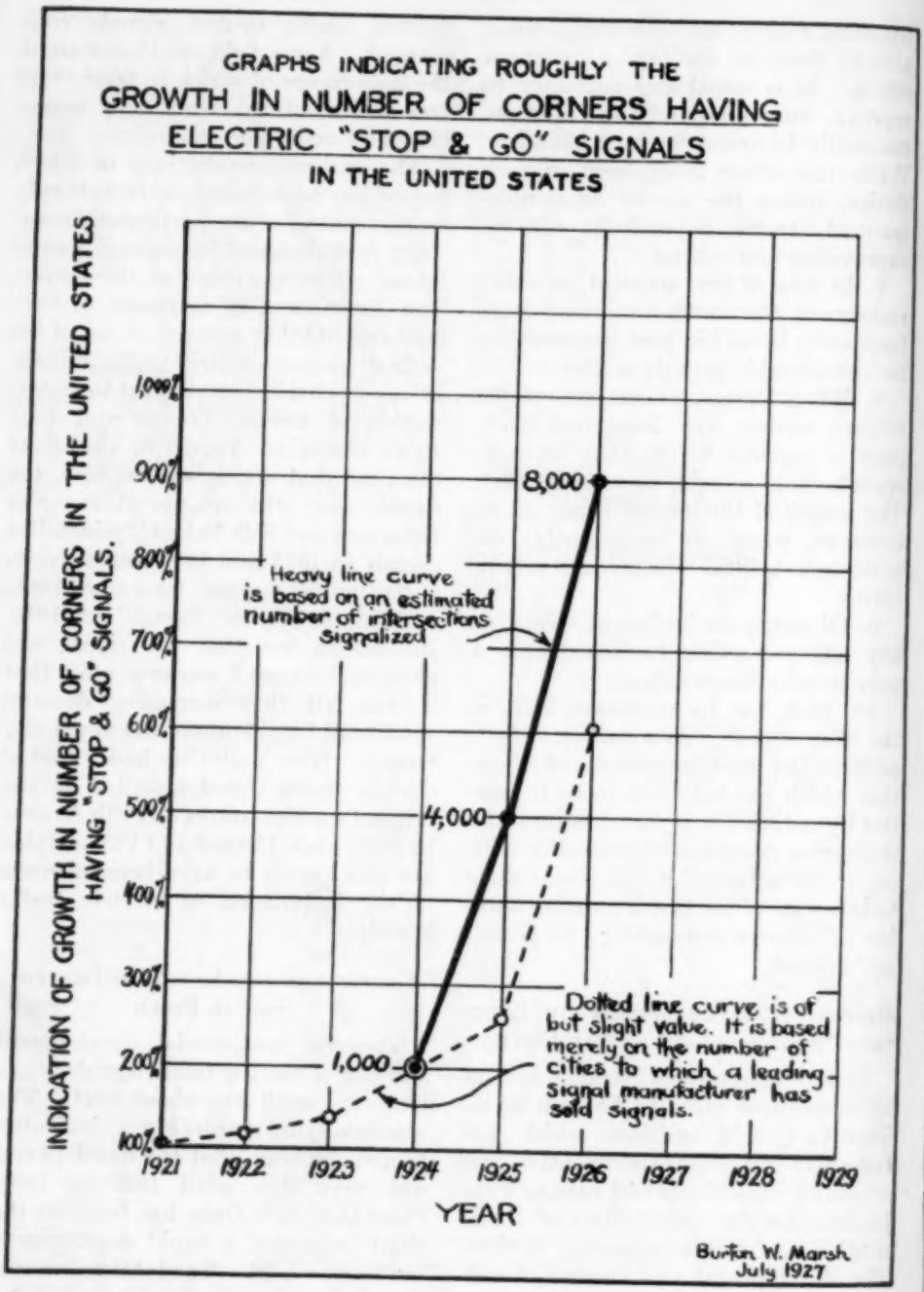

GRAPHS INDICATING ROUGHLY THE
GROWTH IN NUMBER OF CORNERS HAVING
ELECTRIC "STOP & GO" SIGNALS
IN THE UNITED STATES
INDICATION OF GROWTH IN NUMBER OF CORNERS IN THE UNITED STATES HAVING "STOP & GO" SIGNALS.
1,000%
900%
800%
700%
600%
500%
400%
300%
200%
100%
8,000
14,000
1,000
Heavy line curve is based on an estimated number of intersections signalized
Dotted line curve is of but slight value. It is based merely on the number of cities to which a leading Signal manufacturer has sold signals.
1921
1922
1923
1924
1925
1926
1927
1928
1929
YEAR
Burton W. Marsh
July 1927

FIGURE 2

thousand intersections signalized. Development costs and costs of making the very rapid improvements in signals and in control equipment, have been and continue to be so great that it is certainly safe to say that the industry has not been a highly profitable one.

Although there will doubtless be improvements from time to time, the design of the traffic signal units themselves has progressed considerably towards standardization. Signals with a very satisfactory efficiency are being manufactured today by a few companies. Although the signals themselves—the housing, optical systems, and lenses—are being changed but little by the leading manufacturers, a very rapid development is taking place in the field of control mechanisms. Space prevents discussion of this most important and interesting field.

SIGNALS FOR INDIVIDUAL, ISOLATED INTERSECTIONS

The earliest signals were for the control of one intersection. The control was first manual, by means of hand switching devices. Later, automatic timers or controllers were used; naturally, at first, with provisions for switching onto manual control. Still later it was found through experience that certain intersections could be controlled satisfactorily by automatic controllers only. Municipalities quickly became interested in automatic control as a means of taking care of intersections where officers could not possibly be provided.

Especially in view of the large number of "isolated" signals which are used, it is worthwhile to consider some of their most important advantages, limitations, and disadvantages.

1. As indicated above, perhaps the main advantage of the modern automatic traffic signal at an isolated intersection is the saving in cost as compared to control by a traffic officer. Figure 3 gives what is believed to be a fair cost estimate for an overhead-wired, pedestal-mounted signal as compared with a traffic officer, in Pittsburgh. It shows that even with twenty-four

FIGURE 3

hours a day service, the signal, assuming a life of only five years, will have cost less than one-third the cost of an officer for eight hours daily duty. In some cases the electric signal permits the shifting of the officer to a more important post.

2. Although perhaps surprising at first thought, the signal seems to have a greater *attention-compelling value* than an officer. It attracts attention at a distance, and with considerable traffic at the intersection, properly located signal equipment can undoubtedly be seen more quickly and easily than an officer.

3. It generally reduces accidents.

4. Aid to pedestrians. The signal provides control at points where finances would not permit manual control. This is helpful to pedestrians as well as to vehicular traffic. Such a remark as the following is frequently heard: "That light at Dallas and Penn Avenues is certainly fine. I can now cross the street in safety, whereas I often had to wait four or five minutes, and then rush madly across."

5. Barring trouble, which with high-grade equipment is not very frequent, the signal is *always on the job* handling traffic with steady regularity during the hours it is used.

6. At important intersections on heavy through routes, a traffic signal is often the only method beside officer control, by which vehicles from the side streets can secure a reasonable and safe period to cross the main artery.

7. At certain six-way, or otherwise complicated-movement intersections, or close-intersection groups which must be treated as a unit, automatic control can often be designed to allot time to different movements more efficiently than does officer control.

To meet with approval, traffic signals must first be located at intersections where there is a sufficient volume of traffic in each direction and where other conditions warrant them. Secondly, they must be properly designed and erected so as to *compel the attention* of all traffic. Third, they must be properly controlled and timed; and, fourth, properly operated and maintained. Finally, obedience to them must be enforced.

The major criticism against traffic signals has come because proper studies and arrangements have not been made to insure that the above-named essentials are complied with. Thus, for example, because of the desire to "keep up with the Joneses" many communities have installed signals in a very haphazard fashion. Almost every driver has encountered signals at intersections of trunk-line highways with unimportant local side streets, where the signal gives as much time for movement on the side street as on the main highway. State highway officials have become very much concerned about these obstructions to "main line" traffic. In New Jersey very drastic regulations were made, one of the most important of which was the requirement of manual control of signals on state highways.

LIMITATIONS AND DISADVANTAGES OF AUTOMATIC SIGNALS

1. To be generally understood, traffic signals must have only a few lights, and these must have definite, simple meanings. The fewer left turns the more satisfactorily will signal control handle the situation.

2. Unless resettings are made on the timer mechanism, a constant percentage of the total cycle is always allotted to each street.

(*Note*: One complete typical "cycle" at Main Street and "A" Avenue would include a "go" period on Main Street a "clear intersection" period, a "stop" period on Main Street (when "A" Avenue traffic moves), and a second "clear intersection" period. The cycle would be completed as the signal shifted back to "go" on Main Street again.)

Since a constant percentage of this cycle is given to each street, it is evident that the signal will not prove entirely satisfactory if the relative proportions of traffic on the intersecting streets vary greatly while the signal is in use.

3. The signal requires proper maintenance service, including the replacement of bulbs, cleaning of lenses and of the entire signal, oiling or greasing the controller (or timer mechanism), repairing controllers when necessary and giving them a general overhauling at stated periods. Municipalities are too apt to feel that once they have installed a signal it will go on, like Tennyson's brook.

4. At best, the signal will at times hold up traffic unnecessarily. If, however, drivers realize that generally at the corner in question there is considerable traffic crossing on the other street, they will be willing both for

safety's sake and to play their part in aiding traffic movement, to wait reasonable periods for their "go" signal. The short total cycle has rapidly come into favor. With it, both vehicles and pedestrians have to wait shorter periods of time.

5. There is an unfortunate tendency to regard a traffic signal as a *cure-all*. Thus, they may be installed where their only possible justification is accident prevention. As a general rule, unless the volumes of vehicular and pedestrian traffic are nearly enough to warrant a signal for traffic movement reasons alone, other means should be used to prevent accidents. Required, momentary "safety stops" would be entirely satisfactory in many such cases.

In summary, the main limitations and disadvantages of the traffic signal must always be kept in mind. Being a mechanical device, it controls traffic with machine-like regularity and constancy, but of course without brains. To be successful, conditions must be such that this sort of control is satisfactory for the corner in question.

SIGNALS "TIED-TOGETHER" INTO CONTROL SYSTEMS

As already indicated, the idea of relating the movement of traffic at various intersections on an artery, was conceived early. The first thought as to the proper method of doing this, was to have the main street "go" periods occur at the same time at all intersections along the artery. This type of traffic movement is now brought about by what is most generally called the "synchronized" control system. Following the early efforts in New York City with flags and semaphores, wooden towers were installed on Fifth Avenue in 1918, in order that officers might synchronize their "go" periods. Police officers were stationed in these towers, which were built high so that they could be visible one from the other, and the electric signals were visually relayed along the system by individual manual controls in each tower. This was probably the pioneer case in which lights were used in the attempt to synchronize traffic movement. Dr. J. A. Harriss, then special Deputy Police Commissioner, deserves much credit for this early pioneer work. (In 1922 or 1923 the present bronze towers replaced the wooden ones.) Detroit erected towers for the same purpose shortly after New York did.

It is interesting to note that, in these two pioneer cases, the purpose of the lights was merely to indicate to the officers in the towers when to change their signals.

Houston, Texas, in February, 1922, installed at nine adjacent intersections what was probably the first electrically interlocked traffic signal system in the country. The lights in this system were intended to control the movement of traffic directly, with, of course, the assistance at first of traffic officers. In this case, as in most of the early installations, the changing of the lights was done manually by an officer at the most important or "key" intersection.

AUTOMATIC SYNCHRONIZED CONTROL

The next development as to method of control was the utilization of an automatic controller to bring about the changing of the signal colors. The traffic cycle (which it is interesting to note was generally quite long in the early days) was divided so as to give the best results at the most critical intersection. Most of the later synchronized systems used automatic control all or most of the time.

Advantages

The synchronized control idea met with considerable popular approval.

It *looked* good, and indeed it was good in that it introduced the idea of a relationship between traffic signal colors at various corners along the artery—and hence a relationship between traffic movements. The idea that traffic would cross the main artery at all side streets at one time also seemed to mean a greater efficiency, of traffic movement on the main artery. As cross traffic was usually considerably lighter than main artery traffic even at the critical corner, the controller was set to give a long period for movement on the main street. During this long period, traffic moved considerable distances, instead of having to stop at a large number of intersections when they were controlled individually.

Disadvantages

1. Drivers soon find that under synchronized control, the thing to do is to see how many intersections can be passed before the lights changed, so as to be stopped the fewest possible number of times in passing through the system. Such a system, therefore, *encourages speeding.* The accident hazard is naturally increased, pedestrians being those who suffer the most.

2. This system does not permit continuous movement, except in very short systems where the driver races all the way through before the "stop" light appears.

3. This system practically always results in long main artery periods so that the vehicle driver on the main street will be enabled to go a considerable distance before being stopped. Such long periods penalize the waiting driver on the side street tremendously. When traffic on the main street is finally stopped, it must wait for considerable periods because of the long time traffic has been accumulating on the side streets.

Furthermore, the willingness of pedestrians to move only *with* the traffic signal diminishes rapidly as the waiting period increases over about thirty seconds, except in cases when traffic continues to move in a practically solid stream. Hence, in general, long cycles tend to increase considerably the number of pedestrians who cross against the signal—even despite the great risk. (See Figure 4.)

FIGURE 4

4. With a synchronized system the cycle is generally split so as best to take care of the most troublesome intersection. Naturally traffic, especially on cross streets, must suffer at all other intersections—and the greater the differences in cross traffic, the greater the penalties imposed. Sometimes if there are several important or troublesome intersections, a compromise timing is adopted.

5. The high speed of traffic *while in motion* often gives a false impression as to the average or over-all speed (stops included). For example, the casual observer would say that the speed of synchronized movement on Michigan Boulevard in Chicago is high because vehicles seen in motion move so rapidly. Because of the rather long stops, however, checks indicate that the average speed is only about eleven miles per hour.

6. Wherever street cars use a street having synchronized control, it is

evident that when all main street lights turn green, all waiting street cars start simultaneously. This means a serious increase in the peak power demand. Experience on Euclid Avenue in Cleveland indicated a 17 per cent increased peak power demand. The greater the number of intersections under synchronized control, the more important is this factor.

For simplicity sake, the discussion above has been given for one artery. The synchronized system has, however, been used for business districts including a number of streets. Space does not permit amplification of the discussion for such cases. In general, the principles are the same.

Although there are a considerable number of synchronized systems still in use, few *new* synchronized systems based on proper engineering study, are being installed. Systems, designed to permit *continuous movement* on a given street, are now being installed in place of synchronized systems, in some cases without additional cost. Furthermore, numerous synchronized systems have been, or will soon be, converted to one of the progressive or continuous movement systems.

SYSTEMS PERMITTING CONTINUOUS OR "PROGRESSIVE" MOVEMENT

In general, a progressive or continuous movement system is one in which, if a driver starts at the first signal at the beginning of the green "go" period and proceeds at the proper speed, the signal lights at succeeding corners change to green in his favor as he approaches them.

The idea of progressive systems is found in print as early as 1916, when a statement by Mr. John P. Fox gave Mr. Ernest P. Goodrich the credit for the suggestion of a system of signals to accomplish the continuous movement idea. It seems that Mr. Fox and others also conceived the idea about the same time.

In 1918, Salt Lake City installed a system employing this principle. About 1923, Los Angeles also installed a partially progressive system. About 1924, Lancaster, Pa., also used this principle. During 1925 and 1926, several systems were installed embodying the progressive movement idea. Although all used the same basic principle of continuous movement, several different control plans have been developed. Of these plans, two have received major attention. Because of marked differences mainly in flexibility, separate names have been given these two kinds of systems. Several different names are in current use for each system. There is a very evident need of standardization in nomenclature. The two systems as treated in this paper will be called the "*Limited* Progressive Control System" and the "*Flexible* Progressive Control System." They might also be called "*Limited*" and "*Flexible*" *Continuous Movement* Systems.

"LIMITED PROGRESSIVE" CONTROL SYSTEM

This system is also called Reciprocal, Staggered, Reversed Synchronized, Partial Platoon, and Wave System. It is in reality a rather direct (and incidentally easily effected) departure from the synchronized system. In this system, all lights change color at exactly the same time, but on a given street they do not all show green at the same time. Instead, the lights are grouped as to color. Lights at three intersections may show green while lights at the next three intersections show red, and vice versa; or the groups may be made up of two lights each; or each light may be opposite in color from the light one block away. Consider the case of the opposite light

colors at adjacent corners. The driver passes the first light just after it becomes green. If he moves the length of the block at the proper speed, the light at the corner ahead of him, which has been red, changes to green in his favor and he passes through without stopping. Thus he proceeds with continuous movement along the street.

Assume a solid stream of vehicles waiting to enter the system at the first corner. While the light shows green, a group of vehicles enters the system, and, as explained above, proceeds through without stopping. The first light then turns red, and for a period no vehicles enter the system. Then the light changes to green again and another group is admitted. The red light periods create spaces between groups of traffic, and it is in these spaces that side-street traffic crosses the street in question.

Exactly the same operation takes place if a "gridiron" of streets is operated under this system. (Note Figure 5.) In the case illustrated, lights on each of the six streets shown, alternate in color at each intersection. By following the heavy arrows marked A, B, C, and D through the four periods shown, one may quickly grasp the idea of the Limited Progressive System, both as regards the movement of any one group of vehicles through the various lights, and as to how traffic on side streets gets across the street in question between its moving groups.

Among the earliest installations of this type were the following: Salt Lake City, installed in 1918; Lancaster, Pa., installed about 1924; Minneapolis, installed in 1925; and Washington, D. C., in 1926.

Practically all such installations are controlled automatically, though there may be switches for local manual control at the different corners.

The term "Limited Progressive" is relative as compared with the "Flexible Progressive" Control System described later. A brief description of the wiring possibilities will indicate why the word "Limited" is used.

One control mechanism operates all signal lights, and a change in color takes place at the same instant at each signal. Assuming that each signal is reversed in color from the adjacent one, during the period when the green "go" signal shows on the main street at the first corner, the signal at the next corner must for the same length of time show red on the main street, and vice versa.

Suppose that at the first corner 70 per cent of the cycle were allotted to the "go" period on the main street. If the controller were set to give this, 70 per cent of the cycle would automatically be given to the red "stop" light on the main street at the second corner. This would mean that at the second corner, only 30 per cent of the cycle would be allotted to the main street "go" period. If the total cycle were one hundred seconds in length, "go" periods along the main street would be 70 seconds, 30 seconds, 70 seconds, 30 seconds, etc. Obviously, this would be an extremely unsatisfactory arrangement.

With this simple reversed light system, the most practical splitting of the cycle is to make the red and green periods equal,—and this is what is done. Hence, traffic on the main street has the same length of "go" period as traffic on all cross streets. In general, this is not the most desirable apportioning of the cycle for *any* corner. Hence, by the adoption of this system, a very important *limitation* is immediately set up—hence the term "*limited* Progressive Control System."

COLOR GROUPING OF LIGHTS

Partially, perhaps, due to the long cycles which were inherent with syn-

DIAGRAMMATIC REPRESENTATION OF

PROGRESSIVE MOVEMENT OF TRAFFIC

BY GROUPS OR "PLATOONS" THROUGH A

"LIMITED PROGRESSIVE" TRAFFIC CONTROL SYSTEM

MEANING OF SIGNAL SYMBOL — STOP (GO / GO) STOP

NOTE: EACH SIGNAL SHOWN IS JUST STARTING ITS "STOP or GO" PERIOD.

PERIOD NO. 1

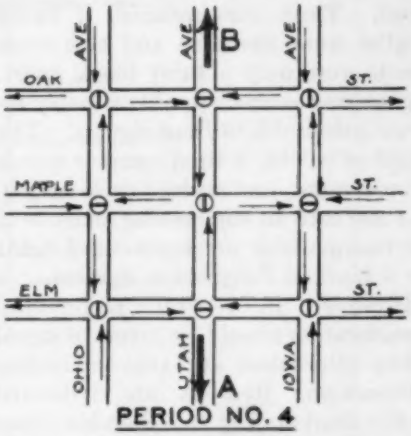
Note that groups of traffic C & D are just about to pass through the intersection of Maple St & Utah Ave. Groups A & B are about to pass through intersections one block away.

PERIOD NO. 2

All signals have changed. Groups C & D have cleared the intersection of Maple St & Utah Ave. Groups A & B arrived at this corner just as signal changed to "Go" for them.

PERIOD NO. 3

All signals have just changed again. Groups C & D have each passed through another intersection. Groups A & B have just passed through the intersection of Maple St. & Utah Ave.



PERIOD NO. 4

Signals have just changed again. Groups C & D have passed out of the district shown WITHOUT HAVING MADE ANY STOP. Groups A & B, which have also MOVED CONTINUOUSLY, are about to leave the district.

Burton W. Marsh – July 1927

FIGURE 5

chronized systems, Limited Progressive signals were at first often grouped with several intersections showing the same color. In quite a number of cases, typical of which are Columbus and Cincinnati, Ohio, changes were made after trials, so that finally opposite signal colors showed at each succeeding intersection along the street. Realization of the advantages of a short cycle doubtless played a part in these changes. The changes, were, moreover, theoretically sound, as study of Fig. 6 indicates.

In order to be successful, each signal system installation should be preceded by a careful engineering survey. If such a survey is made, the many peculiar local conditions involved may be properly taken into account, the characteristics of traffic accurately measured, and all factors given proper weight. If a Limited Progressive System should be decided upon it might well be that certain multiple groupings would be found to be advantageous. Thus, for instance, if block lengths were irregular and two cross streets were only a short block apart, engineering analysis would probably indicate it desirable to group signals. The length of blocks, desired speed or speeds of movement, and desired cycle length, all enter into an engineering analysis of the best possible arrangement of lights for a Limited Progressive System.

However, in general, preferential consideration should be given to signal colors alternated at each succeeding intersection. Reasons are indicated by the charts in Fig. 6. Plan No. 1 has like-colored lights in groups of three intersections along "Main Street." The desired speed of movement is 13.6 miles per hour. With this speed and color grouping, and with block lengths of four hundred feet, the proper cycle length is found to be 120 seconds. Follow the No. 1 group up the sheet, which means up "Main Street." Note that the heavy bars at each cross street indicate the periods when the signal shows red on "Main Street," and that the spaces between indicate "go" periods on "Main Street." "A," "B," and "C" Streets have the green "go" period together when the first vehicle starts along "Main Street" (when the "time in seconds" is zero). This first vehicle (represented by the left-hand side of the No. 1 group of "band" arrives at "D" Street just as the signal changes to "go." This leading vehicle and group No. 1, immediately behind it, proceed through lights at "D," "E," and "F" Streets, which lights now all show "go" at the same time. No. 1 group arrives at "G" Street just as the light there changes to green. If the chart were more extensive, it would show this first group proceeding through "G," "H," and "I" Streets while the lights at all three streets show the same color—and so on. It is evident, therefore, that this group does *move continuously*. Note, however, that this group is only one-third of the original solid line of vehicles which passed through the signal "A" Street on the first "go" period.

Follow the group of traffic, which starts off as No. 2. It proceeds to "C" Street, and there encounters the red light (indicated by the heavy line). It waits at "C" Street until the light changes to green, when it moves to "D" Street, only to again encounter a red signal. This group waits at "D" Street (the first street in the second signal-color group) until the green light appears. From that time on this group moves continuously.

Similarly, follow Group No. 3, noting that it is stopped by a red light at "B," "D," "F," and "G" Streets. Starting with the green light at "G" Street, this group can proceed continuously

GRAPHS SHOWING

COMPARISON OF TRAFFIC M

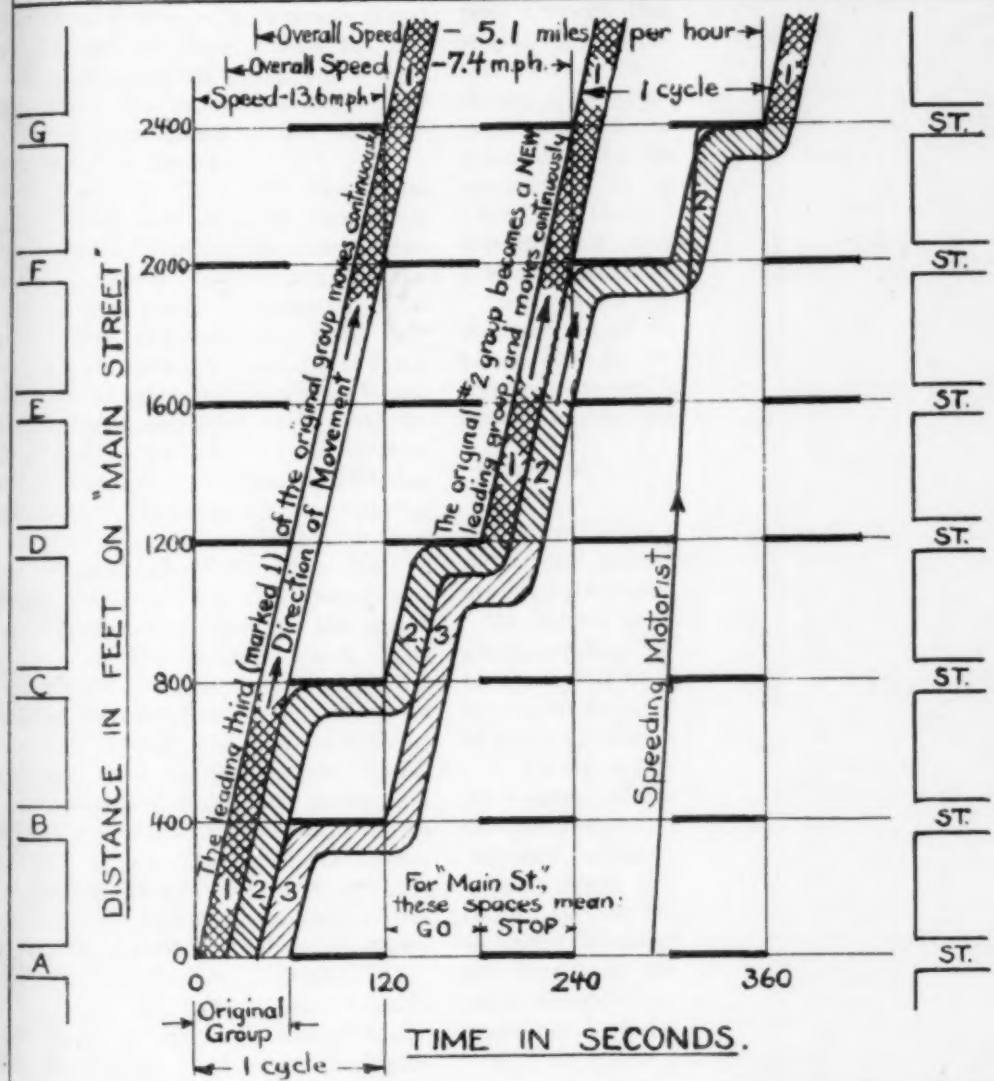
ON "MAIN STREET" WITH TWO DIFFERENTLY ARRANGED TRAFFIC CONTROL SYSTEMS

Note: For Simplicity, both Graphs Are Made for Traffic Movement in One Direction only. For the Same Re

PLAN #1.

THREE INTERSECTIONS TO EACH COLOR GROUP.

This plan has like-colored lights showing synchronously in groups of three intersections, each group having its signal color reversed from the next group color. Cycle Length — 120 Seconds.



SIGNAL COLOR

With this plan, any
at the next intersection
Cy

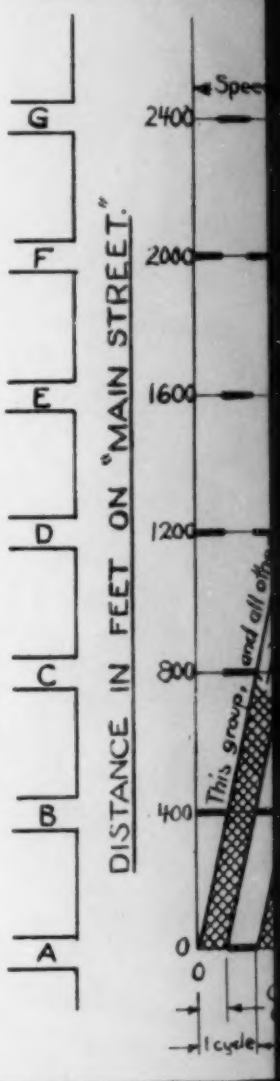


FIGURE 6

WING

AFFIC MOVEMENTS

Y ARRANGED "LIMITED PROGRESSIVE" DL SYSTEMS.

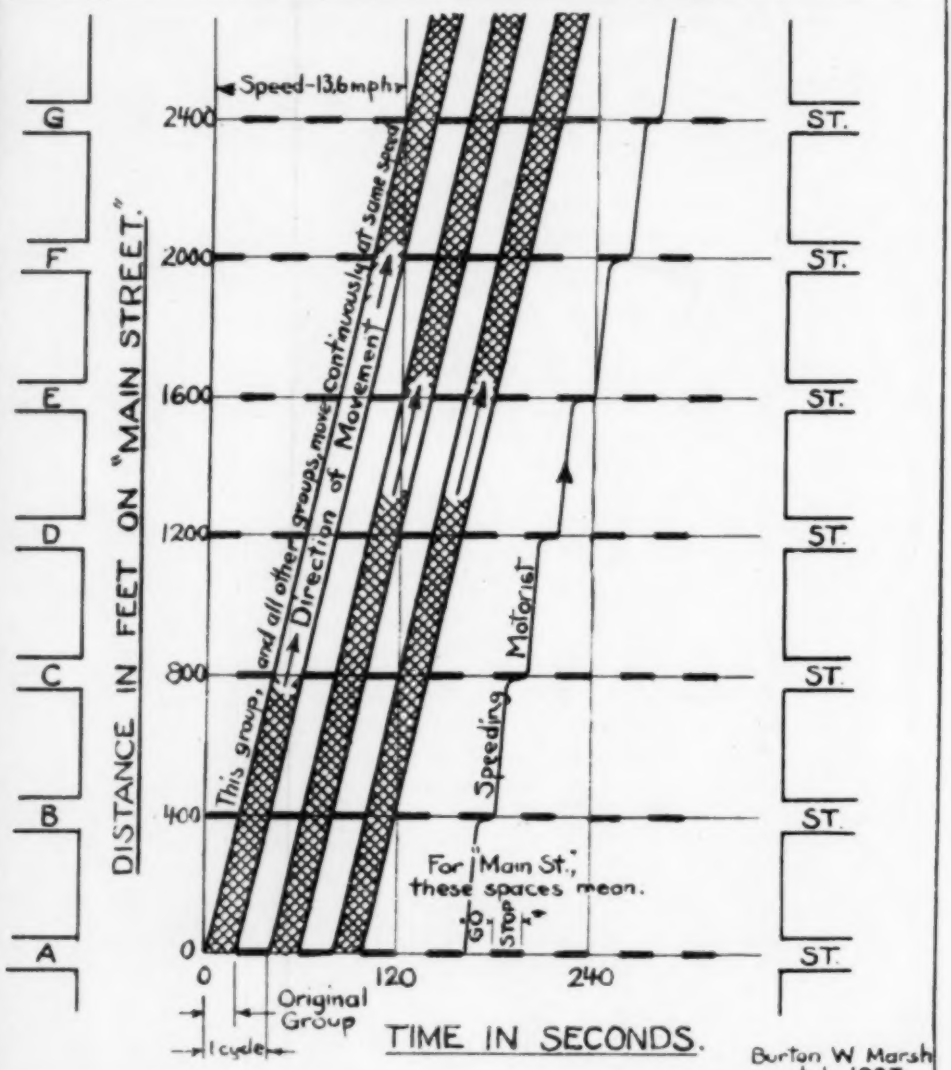
nly. For the Same Reason, the Amber Periods Are Not Indicated

PLAN #2.

SIGNAL COLORS ALTERNATED EACH BLOCK.

With this plan, any intersection's signal color is green when the color t the next intersection in both directions is red, and vice versa

Cycle Length — 40 Seconds.



through the remainder of the Signalized district (not shown).

In summary, it will be noted that the first third of the original "solid" line of traffic moves continuously through the system at the desired speed of 13.6 miles per hour. The second group moves from "A" to "G" Street at an average or over-all speed (including stops) of 7.4 miles per hour, while the third part of the original group moves to "G" Street after being stopped at four intersections, at an average speed of 5.1 miles per hour. *Only the first third of the original group moves continuously. The second and third parts of the original group do not move efficiently under this plan.*

Plan No. 2: This plan has signal colors alternated at each succeeding intersection. Exactly the same section of "Main Street" is indicated, and the desired speed is still 13.6 miles per hour. Under this arrangement, note first that the proper cycle length is forty seconds—thus immediately introducing the advantageous short cycle (with its short waiting periods for both vehicles and pedestrians). Of course, with this cycle length, the original group entering on a green light is much shorter than the original group in Plan No. 1. Note, however, that this group proceeds continuously through the entire system at the desired speed. The next group of traffic, indicated by the middle cross-hatched "band," likewise proceeds through the system without stopping, and at the desired speed. This is also true of the third group, and would be true of any group entering on a "go" light. This plan, therefore, has the great advantages of a short cycle length and of theoretically *continuous movement* for each entire group through the signalized district.

For simplicity, in both plans 1 and 2, movement of traffic is indicated in one direction only. The same principles would apply, and the same results would be obtained, for traffic moving in the opposite direction. Also, in order to avoid complications, no amber periods are indicated. The effect of the amber period is mainly to reduce somewhat the number of vehicles in each group.

A further advantage of Plan No. 2 is that vehicle drivers would soon come to know, under Plan No. 1, that if they raced at high speed they would usually pass through the system with fewer stops. The "wise" driver would therefore exceed the desired speed on the street, thus producing somewhat the same accident hazard noted against synchronized systems. As against this temptation to speeding, note under Plan No. 2 that all vehicles move under definite and positive control, at the desired speed.

Best results are obtained when the distance which must be traveled between changes of light color are uniform—provided the same speed is desired along the entire street.

ADVANTAGES OF LIMITED PROGRESSIVE SYSTEM

1. Continuous progressive movement, and hence increased efficiency, are brought about on all streets.

As shown above, where conditions are favorable, lights alternated every block should be given first consideration in obtaining continuous movement of the largest number of vehicles.

2. Speed control is most complete with signals alternated every block, as described above. A driver *could* speed between intersections, but he would quickly learn that such speeding required him to wait for the green light at every intersection. By increasing the length of the total cycle during peak hours, the continuous-moving speed can be reduced.

3. This system, especially with lights

alternated every block, in general permits the use of a short cycle. This means that neither motorist nor pedestrian is forced to wait long. Such short waiting periods bring a most valuable psychological reaction, aiding greatly in making the system popular and in securing willing observance.

4. Pedestrians are given an opportunity to cross streets on their own "go" period, often without long waiting periods.

5. The definite speed control of Plan 2 is the main safety factor, but the short cycle also encourages observance of signals by pedestrians, which also helps to reduce accidents.

6. As compared with certain types of Flexible Progressive systems to be described, this system is relatively inexpensive to install. The system costs practically the same as the Synchronized System.

DISADVANTAGES OF LIMITED PROGRESSIVE SYSTEM

1. Practical necessity of making all "Stop" periods equal in length to all "Go" periods. Except in unusual cases of very evenly distributed traffic, efficient utilization of the cycle is not possible at any corner.

2. All signals must change to the opposite color at exactly the same time. If block lengths are unequal, it is impossible for a driver to move continuously at a constant speed. Even if block lengths are identical, there may be conditions which call for a different speed in various blocks. This system lacks flexibility in handling such cases.

3. Street car peak power demands are somewhat greater than with the flexible Progressive System, but by no means as great as with the Synchronized System.

4. Conditions must be favorable. If the average length of blocks is small, the cycles must either be too short, the speed too low, or the lights must be grouped, often in ways which are not efficient. A period of eighteen seconds seems to be about a reasonable minimum period, although in special cases with practically no cross traffic, even shorter periods have been used. Especially outside of business districts, blocks may be too long to make it worth while to utilize this system with the usual single controller operating the system from a central control point. Because of variations in speed, delays, etc., it is usually of little benefit to "tie-together" by means of wires, signals more than one thousand to twelve hundred feet apart.

Other factors which must be reasonably favorable are: the street layout plan, parking conditions, street car conditions, and the number of lanes available for traffic movement.

"FLEXIBLE PROGRESSIVE" CONTROL SYSTEM

This system is also known as the Platoon System and the Coördinated System.

On February 7, 1926, in the Chicago Loop District, an electric traffic control system was first placed in operation, the basic principles and flexibility of operation of which may fairly be said to have marked a new era in the field of traffic control systems. For the first time, the idea of a really flexible continuous traffic movement was developed. Credit for the development of this flexible progressive movement system belongs to Mr. E. J. McIlraith, Staff Engineer, and to Mr. H. B. Cammack, both of the Chicago Surface Lines.

It is highly significant to note that this development resulted from the application of competent and thorough engineering analysis to the traffic movement problem.

This system embodies the progressive or continuous movement idea. It

reduces, however, the serious handicap of the Limited Progressive System in that the percentage of the total cycle apportioned to movement on each street at any intersection may be varied to take account of the time demands of traffic on each street. This system also removes another serious limitation of the Limited Progressive System. Although the total cycle is constant over the entire controlled area, the time when the green light appears may be selected at will—an important advantage. For example, assume a vehicle starting at the first corner just as the green light appears. If, at a desired speed of twenty-two miles an hour, it would take twenty seconds to traverse the first block, the signal at the second intersection could be arranged so that its green light would appear at the end of this twenty-second period. Now, suppose that the next block were considerably longer so that it required thirty-two seconds for this constant-speed-vehicle to traverse it. This *flexible* progressive system would permit the signal at the third intersection to have its "go" period start thirty-two seconds after that at the second intersection.

Moreover, with this system the time splitting of the total cycle at any intersection may be readily changed at any time—as may also the difference in the time when the green light appears at each corner. It is for the above very important reasons that the writer calls this system the "Flexible Progressive" System.

Aside from two installations in Chicago, flexible progressive systems are also in operation in Cleveland and East Cleveland, in Detroit and in Des Moines. This functional type of system is rapidly coming into favor, it being generally recognized as basically correct in principle. Chicago is planning this type of control on other arteries including Michigan Boulevard; and engineering studies for utilization of this general principle are being made in San Francisco, Boston and Pittsburgh. The Carnegie Avenue installation in Cleveland is four miles in length, probably the longest stretch of one street under flexible progressive control in the world.

Considering the development of the science of traffic control, reference should be made to the fact that the flexible progressive systems mentioned above as in actual operation, have full automatic control. Electrical devices can be, and in some cases are, installed to make possible manual control at each corner, or from different corners. It is evident that local manual control from any point, can scarcely avoid interfering with the full coördination of the system.

ADVANTAGES OF THE FLEXIBLE PROGRESSIVE SYSTEM

This system has all the advantages of the Limited Progressive System, and has much greater flexibility. The main advantages are:

1. Continuous progressive movement under the most flexible system yet devised. This means a maximum of efficiency in street use.

2. Wide range of flexibility. Functionally, this item includes:

(a) The possibility of having the green light start at any desired second at each corner, and the ability to promptly and easily change this setting, and to reëstablish any desired setting in case of trouble.

(b) Ability to split the total cycle so as to give any desired percentage to either street, and to change this percentage at will.

The careful reader may wonder how an approximately constant volume of traffic on the main street may progress continuously and satisfactorily with

different actual main street "go" periods at succeeding intersections. In order to progress satisfactorily under these conditions, the corner having the smallest actual "go" period on the main street, must be used more efficiently or more nearly to its ultimate capacity, whereas as the actual "go" period on the main street increases at other corners, the street may be used less nearly to its capacity (more leisurely). Another factor which enters is that, in practice, groups proceeding on a street are not constant in size or movement throughout their trip along the street. Vehicles are stopping, and pulling out from the curb, and turning vehicles are continually leaving or joining the group.

(c) Positive control of the length of the total cycle so that it is exactly the same length at all intersections—yet, so that its length may be increased or decreased, as on rainy days or during peak hours. There is some discussion as to the necessity of changing the total cycle length. Those who feel that it is not necessary, would adopt the total cycle best suited to worst peak hour conditions. Traffic during other hours would move somewhat more slowly than it would need to, but those who favor the constant cycle length claim that this decrease in speed would not be very considerable and would therefore be relatively unimportant. Others feel that this added flexibility is important enough to warrant provision for it despite added cost, especially considering the possibilities of new developments in the use of the system.

(d) The ability to adopt any amber periods within reasonable limits and to change the length of the amber periods within reasonable limits. The original Chicago installation did not provide for simple and quick changing of the amber.

(e) Ability to alter any of these items without affecting any other item as to the main street, except possibly in a minor way as relates to changes in the amber periods.

A reasonably short cycle is usually adopted for such systems. This introduces the same desirable features already mentioned—neither vehicle driver nor pedestrian is required to wait long.

DISADVANTAGES OF THE FLEXIBLE PROGRESSIVE SYSTEM

1. Cost. As stated above, the Chicago system is very expensive. The high cost disadvantage of this general functional system is being removed in later designs and installations.

2. The Chicago Loop System is rather complicated and intricate, mechanically and electrically. While some of these complications are being removed in later developments, this Flexible Progressive System will always require a higher grade of supervision and maintenance than the relatively simple electrical systems heretofore described.

3. For the Chicago Loop System, considerable duct space was required, since power wires were connected directly from individual signals to the central control room.

4. In the Chicago system, different lengths of circuits bring about different voltage-drops. In order to overcome the voltage-drop to distant points, and to have all lamps burn at normal voltages, the initial voltage is kept high and resistances of the proper values are inserted in the shorter circuits. This method wastes electrical energy. In some of the more recent designs, the power for the individual signal lights is picked up at each intersection from a nearby power line of the proper voltage. This plan eliminates the above

disadvantage, but adds an item of cost for the local "pick-up" of power.

5. The Chicago Loop System as originally designed lacked easy amber variation or adjustment.

6. Where this Flexible Progressive System is used on outlying arteries, through no fault of the system itself but because of the possibility of speed variation and unusual interferences, there is probably little advantage to installing such a system where wires are necessary to inter-connect the signals, if intersections are over one thousand to twelve hundred feet apart. By the use of a synchronous motor, fixed cycle system, which space does not permit describing, this distance can properly be increased, if inter-connection of signals is unnecessary (and it is unnecessary unless central re-synchronizing is desired). Since a less investment is required when no interconnecting wiring is required, the limiting distance between intersections may well be increased up to possibly a quarter of a mile.

7. An inherent requirement of this system is that the total cycle must be constant at every control point. This is necessary in order that the relationship of the beginnings of the "go" periods at adjacent corners will always be the same. Thus, if the cycle at the first intersection were sixty seconds while that at the second intersection were seventy seconds, it is evident that no constant time interval could be maintained as between the time the green light showed at the first corner on the main street, and the time it showed at the second corner on the main street.

It is possible under certain conditions, to utilize to advantage direct multiples of the original cycle. Thus, with blocks twice as long in one direction as in the other, the system might be arranged so that the signal lights on the long-block street would change twice before the group of traffic would arrive at the next intersection. Another illustration of how the multiple cycle can be used is on a wide street-car street. Here the cycle may be set so that free-wheel vehicles may move at say a twenty-mile an hour speed, whereas street cars with their slower inherent speeds considering loading times, may yet move continuously (except for loading and unloading) at half the speed, passing through the second intersection one whole cycle later than the original group of automobiles.

This limitation of a constant total cycle is inherent, but it is, nevertheless, a real limitation which may perhaps best be realized by considering the often considerably different cycle lengths which officers use even during their periods of maximum efficiency—during peak hours. Widely differing block lengths also emphasize this constant cycle limitation.

TRAFFIC SIGNAL SYSTEM EQUIPMENT

Aside from artistic appearance, which has so far been given much too little attention in the design of traffic signals, the following are four items of major importance as concerns the signal system equipment itself:

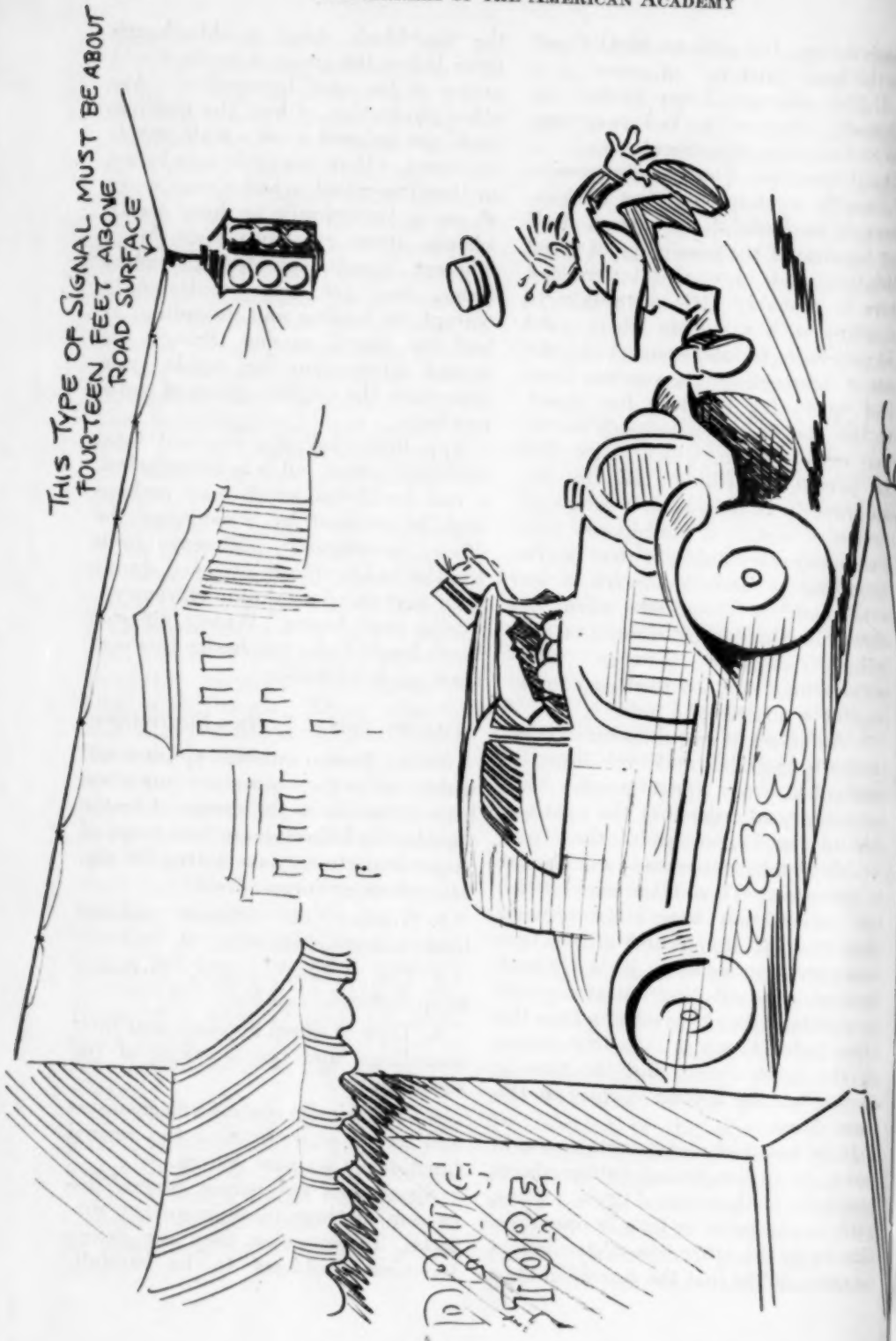
1. Number of different colored lights and their meanings.

2. The optical system, including lamp, reflector, and lens.

3. Type of signal housings and their mountings, and the locations of the signal units.

4. Electrical control mechanisms and means of performing the desired functions in a signal system.

Space does not permit general discussion of these most important subjects. In any case they are clearly technical problems to be carefully


THIS TYPE OF SIGNAL MUST BE ABOUT
FOURTEEN FEET ABOVE
ROAD SURFACE

studied and solved by competent engineers.

However, the results of decisions on these matters are of great interest and importance to the general public. This fact is well brought out by Fig. 7, which illustrates two of the serious disadvantages of pendant type signals suspended from a wire spanning the street. With wide streets this type of signal may be satisfactory, but it generally has serious disadvantages. The illustration shows how it often cannot be seen under the sun visor and how the accident hazard is thereby increased. This type of signal is also expensive and difficult to maintain. It is also often difficult for pedestrians and motorists when near the corner to distinguish in bright sunlight which light is burning. Thus, though the signal may be chosen because of its low *initial* cost, proper engineering consideration might lead to adoption of some other type of signal and method of mounting at the intersection.

The matter of the number of different colored lights and their meanings is also of vital interest to the general public.

NUMBER OF DIFFERENT COLORED LIGHTS AND THEIR MEANINGS

One of the essentials of traffic signals is that the signal lights shall be simple and positive in meaning, so that they may be quickly understood by the general public. Furthermore, in order to utilize the ordinary control systems, the *cycle must be kept quite simple.* Special traffic cycles are possible which have separate periods for turns from each street. Other cycles provide a period exclusively for pedestrian movement. Whereas these special cycles may be desirable under certain conditions, the following traffic cycle is in general use: "Go," "Clear Intersection," "Stop," and "Clear Intersection." The second cycle then starts with "Go" again.

All periods of this customary traffic cycle are essential at every regular intersection under "stop-and-go" control. At the end of the "go" period, no matter what system of lights and colors is used, there must be provided a short period, the purpose of which, in general, is exclusively to clear the intersection of vehicles and pedestrians already in it.

TWO TRAFFIC SIGNAL COLORS STANDARDIZED

The use of green for "go" and red for "stop" has practically become standardized in this country. Concerning the manner of providing the "clear intersection" period, considerable difference of opinion exists today. The most frequently used scheme is a third lens of amber color. Unfortunately, however, the amber lens has been used for many different purposes and no single word can be used to describe accurately its meaning—although the two words "clear intersection" describe quite well the meaning which is most generally intended. The amber has been used for at least the following purposes: Clearing the intersection, warning of change in signal color, providing an exclusive pedestrian period, and as a special signal to make left turns. It has also been used in combination with the red and green lights, with various significances.

It is quite natural, therefore, that the public does not know what to do on the amber light; and, hence, the amber light has not to date "worked out" satisfactorily. Numerous traffic officials have experimented with different meanings of the amber, and hence, could not educate the public in one definite meaning for this light.

There is one further complication as regards the use of the amber light

which is not considered by the great majority of drivers. Suppose the amber is to be used with the significance of "clear intersection." A driver approaching a corner at a permitted speed of twenty-five miles per hour is confronted with the amber when he is twenty feet from the cross-walk. At that speed he cannot possibly stop until he is in the intersection. In this case, the conscientious driver does not know what to do, and here again the significance of the amber is not clear-cut. In other words, there is a point back from the cross-walk a short distance (varying with the speed and brakes), which if the driver has passed when the amber light appears, he cannot possibly stop until he is in the intersection—and after trying to stop he should therefore proceed cautiously through the intersection. If the driver has not reached the critical point just described, he should stop on the amber light.

Evidently, then, there must remain this slight degree of uncertainty concerning the "clear intersection" amber light. The general rule should be: "Make a *real* effort to stop behind the cross-walk. If this is unsuccessful, proceed cautiously through the intersection."

Another difficulty is that whereas about three seconds is roughly ample for vehicles to clear the intersection, eight to ten seconds are needed for pedestrians to clear it. A very short amber does not give pedestrians time to clear the intersection, a long amber tempts motorists to "beat the amber"—that is, to continue moving on the amber in order to pass the signal before it changes to red, or to start on the amber instead of waiting for the green light. Confusion as to the exact meaning of the amber and widely differing lengths of amber, are factors also partly responsible for beating the amber.

Because of these troubles, several different ways of providing for the "clear intersection" function have been tried. Each plan has its objections and most methods have some advantages. The majority of opinions seems to favor the continued use of the amber light. If the amber light could be standardized in meaning as, for instance, to signify only "clear intersection," and then kept fairly short, it is believed the public could soon be educated to a satisfactory observance of the light.

How to Attack the Traffic Signal Installation Problem

The design, erection, operation and maintenance of electric traffic signals and signal systems are fundamentally engineering problems. Unfortunately, most cities have been slow to recognize the need of the traffic engineer. Until haphazard installation of signals is done away with, and careful engineering studies are made prior to installations, cities cannot expect the degree of efficiency and satisfaction with their signal lights to which they are entitled.

Prior to the installation of a signal at an isolated intersection, there should be made a complete traffic count of both pedestrians and vehicles, giving complete data as to numbers and kinds of vehicles making turns at various hours of the day. This count should extend over the period of important use of the intersection. Aside from the hours of, say 7 A.M. to 6 P.M., it is often advisable to make counts at night.

Other data which should be obtained are: (1) Speed of various classes of traffic on the two streets; (2) traffic accidents, with an analysis of the facts; (3) roadway widths—lane use and paving; (4) the effect of street cars, tracks, headways, and stops; (5) grades in the vicinity of the corner; (6) obstructions to vision at or

near the corner; (7) a careful study as to best type and location for signals. These and other factors peculiar to the intersection must all be taken into account in deciding whether or not the signal is warranted, and if so, the type, installation plans and timing.

Survey for Traffic Signal System

A thoroughgoing and complete traffic survey should be made before the installation of any *traffic control system* on a main artery or in any important business district. Such a survey practically must be made under competent engineering guidance. It should include such factors as the following:

1. Volumes of all classes of traffic on each street, including volumes of turning movements made by various kinds of vehicles.

2. Average, maximum, and minimum speeds for various classes of vehicles during the various hours.

3. Street car study. A study of street car schedules, speeds, delays, stops, and loading and unloading characteristics.

4. Study of turns (especially left turns) as to their elimination or how to most efficiently provide for them at each corner.

5. Study of traffic lanes and of their capacities and relative use under different conditions.

6. Study of special intervals used by officers at unusual shaped or otherwise special intersections.

7. A study of special interference or obstruction factors.

8. Studies to determine the most desirable length of the total cycle for all corners.

9. Study to determine the best time-setting for starting the green light at each corner.

10. Studies to determine the best apportioning of the cycle at each corner, including studies of traffic officer's intervals at various times during the day, and analyses of time demands of critical lanes on each street, especially where there are no officers.

11. A study of all electrical problems involved, including availability of duct lines, local pick-up of power, best electrical control apparatus design.

With the data in hand, graphical methods are used to ascertain the best possible length of cycle, speed or speeds of traffic, relationship between the start of the "go" period at various corners, and apportionment of the total cycle at the various corners. Figure 8 is a typical study chart of this sort. The various factors just mentioned have been adjusted on this chart and it represents the final timing decision for the street under study. Space does not permit a detailed explanation of the chart, but a study of it will show that the final arrangement allows the indicated groups or "bands" of traffic to move in each direction continuously. It will be noted, however, that the "go" period is not used to maximum efficiency at all corners. This is practically impossible to expect because of the many inter-related factors all of which cannot be so taken into account as to give 100 per cent use of all "go" periods. The value of continuous movement, however, undoubtedly overbalances the lack of 100 per cent complete use of the "go" period. Under manual control, there is not 100 per cent efficiency in use of "go" periods, either.

RESULTS TO BE EXPECTED

Experience throughout the country clearly shows that where proper studies have *not* been made, signals and systems *often* fail to win the approval of the public. Such signals are inefficient and often actually a nuisance. There are numerous cases where cities

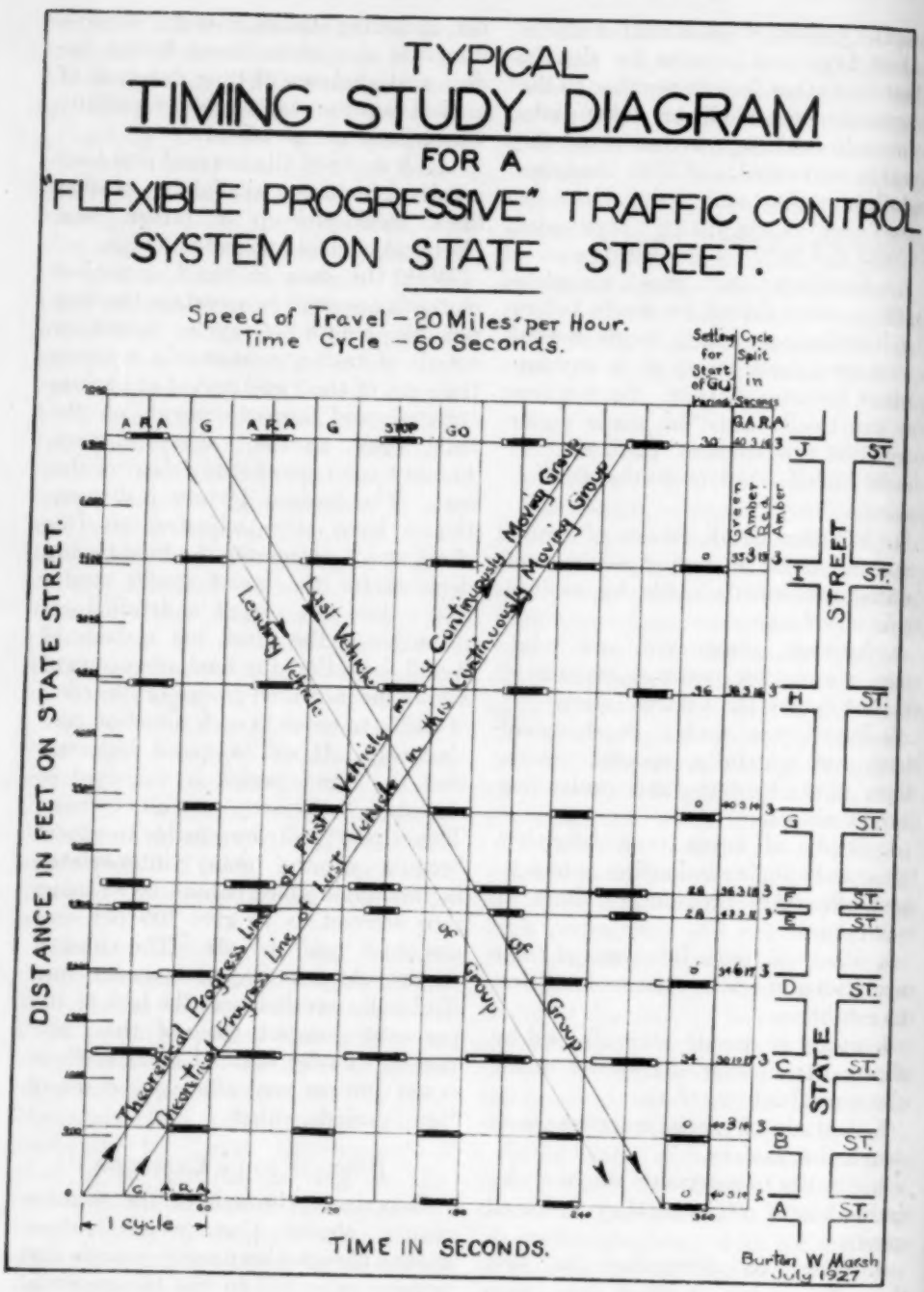

TYPICAL
TIMING STUDY DIAGRAM
FOR A
"FLEXIBLE PROGRESSIVE" TRAFFIC CONTROL
SYSTEM ON STATE STREET.
Speed of Travel – 20 Miles per Hour.
Time Cycle – 60 Seconds.
Setting for Start of Green
Cycle Split in Seconds
G A R A
Green
Amber
Red
Amber
STOP
GO
Leading Vehicle
Last Vehicle in a Continuously Moving Group
Theoretical Progress Line of First Vehicle in a Continuously Moving Group
Theoretical Progress Line of Last Vehicle in this Continuously Moving Group
1 cycle
DISTANCE IN FEET ON STATE STREET.
TIME IN SECONDS.
STATE STREET
J
I
H
G
F
E
D
C
B
A
ST.
Burton W. Marsh
July 1927

FIGURE 8

have installed signals without proper study only to remove them at a later date. One large city has recently discontinued the use of signals on some of the main business streets because the signals were installed with no study to show what the result would be, or how the system should be coördinated, timed and operated. There are numerous cases of this sort. There are many more cases in which signals *should* be removed or should be subjected to proper engineering study and their defects corrected.

The most carefully worked out installations are the ones which are cited as the most satisfactory. Among these are the Chicago Loop System, the Los Angeles System, the Washington System on 16th Street, and the new Cleveland, East Cleveland and Detroit Systems. Facts show that these systems have reduced accidents and have expedited and improved traffic movement. Data from Chicago indicated a reduction in personal injury automobile accidents of 23 per cent after the installation of the loop signal system, and a reduction of 10 per cent in the time necessary to cross the loop. It is believed that the time savings to street cars were even greater.

In Washington, the continuous moving speed of traffic on 16th Street is approximately twenty-two miles an hour, the legal speed limit. Before the signals were installed, the speed was much slower. Records also show a material reduction in accidents.

In Detroit, although the fatal and personal injury traffic accidents for the whole city increased 11 per cent for the year when the traffic signals were first placed in operation, as compared with the year previous, there was a reduction of 3 per cent in such accidents within the one mile circle. It is within this circle that the traffic signal system is in operation downtown, and other signal lights are most frequently encountered.

Los Angeles data and Cleveland and East Cleveland experience also show reductions in accidents and improvements in traffic movement brought about by the installation of the traffic control systems.

In Erie, Pa., the change from a synchronous system to a limited progressive system, installed after study, speeded up street car operation approximately 20 per cent.

In most of these cities, the improvement in pedestrian observance of signals has been very beneficial to the general improvement of traffic conditions. This improved pedestrian observance has also aided in the reduction of accidents.

In conclusion, "stop-and-go traffic control by officers has, in the large cities at least, been developed to a high degree, and the best officers show real efficiency. It is practically impossible, however, to coördinate their efforts so as to secure a continuous movement of traffic. The best traffic control systems devised to date do permit in theory and to a large extent in practice, such continuous movement, and the development of this new field will doubtless be rapid.

To secure the desired efficiency, traffic signals, and especially traffic control systems, should be installed only after thorough studies by competent traffic engineers. After such systems are designed and installed, their operation and maintenance (including constant readjustment of them to better meet changing conditions) should also be under the supervision of qualified engineers.

Facilitation of traffic movement, reduction of accidents, and improved pedestrian observance of signals,—these results may properly be expected from correctly designed, installed, operated and maintained electric traffic control signals and signal systems.

Guiding the Traffic Flow

By Irving C. Moller

Highway Transport and Traffic Control Consultant, Washington, D. C.

TRAFFIC congestion in the metropolitan areas of our large cities has been held responsible for much economic loss of life, limb, and property. The financial value of time lost in passing through the congested sections of our municipalities is enormous. Merchants complain of loss of business due to parking conditions. Collisions occur at busy intersections with resulting property damage and pedestrians are being killed and injured at a rate which makes fair comparison with the nations' losses in the World War. Recent statistics show that a person is killed or injured in a traffic accident every forty-two seconds in the United States.

Problems Paramount

The three outstanding problems which must be solved in connection with any real attempt to relieve the situation are: How to guide the flow of traffic away from congestion; how to speed up traffic with safety; how to reasonably control the movements of pedestrians. The solution of these problems must be handled as a unit because they are so closely allied to one another that it is not possible to separate them in the general scheme of traffic control.

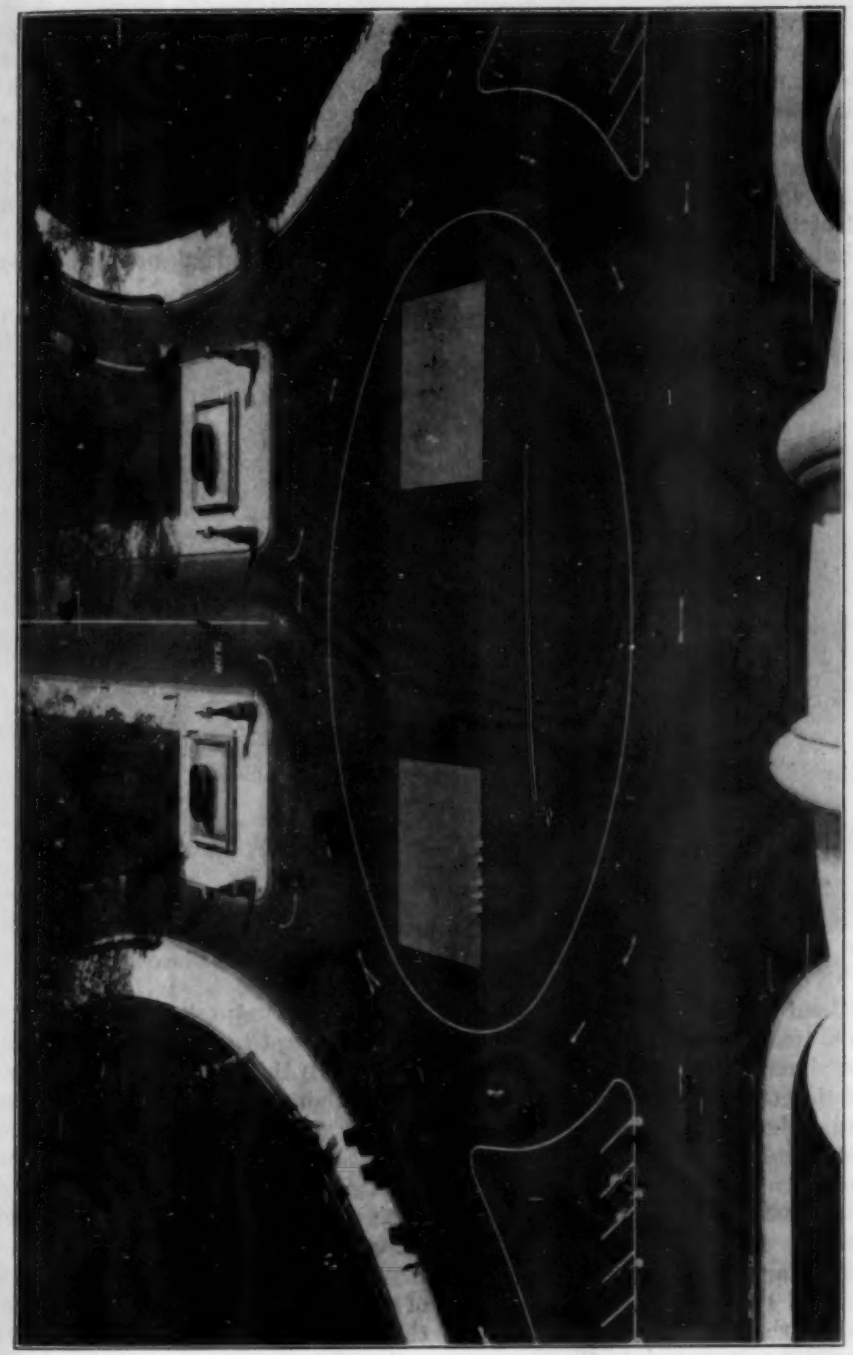
In the past the traffic problem has been looked upon by most municipal officials as purely a police matter. This point of view will have to be changed before any real results can be obtained. An efficient traffic police is essential; but the function of such a body is to enforce the traffic regulations and is in no way concerned with the making of such regulations. No community would think for a minute of allowing the local police officials to make the health regulations or write the building code. Those matters are left to experts as a matter of course, and the making of traffic regulations should be handled in a similar manner, by traffic engineers well versed in theory, economics, and practice of traffic control.

City planners are giving a great deal of study to traffic congestion and its relief. Most of their remedies are, however, elaborate and involve the expenditure of millions of dollars for such things as grade separation, the creation of super-highways to carry the fast through traffic, the relocation of street car tracks and routes, the construction of subways and other similar improvements.

All of these matters are highly essential and most of these studies will eventually become a reality; but what the people want to know is what they can do now, today, to obtain immediate relief from conditions which have, in many cities, become well nigh intolerable. The crying need is for a quick and sure remedy that may be counted upon to afford a large measure of improvement at small cost.

The Survey

The first step in scientific traffic control is the making of a traffic survey. The traffic engineer must know just what his problem is. He cannot guide the flow of traffic along its logical routes and relieve congestion unless he knows where the traffic is coming from, where it is going to, its volume each hour in the day, its turning movements



UNITED STATES CAPITOL PLAZA, WASHINGTON, SHOWING TRAFFIC LANES PAINTED ON THE PAVEMENT

and its speed. He must also become thoroughly familiar with the local situation as regards street car operation and bus routes, the movement of commercial vehicles, the width of pavements, the height of buildings, and parking conditions. Any attempt to regulate traffic without consideration of all of these points will produce at best but temporary relief.

COLUMBUS CIRCLE, NEW YORK CITY, SHOWING TRAFFIC CONGESTION

Without such a survey the engineer cannot tell whether or not electric traffic signals will increase or relieve congestion on a given street. He cannot know how to time such signals in order to secure the greatest benefit for all classes of traffic, and he will not be in a position to decide between the varying merits of synchronized, progressive, and coördinated types of signal control.

None of this knowledge can be obtained without a carefully planned scientifically operated traffic survey. And once the survey has been completed the statistical analysis of its data is a very nice problem requiring a great deal of skill in reducing the information obtained to usable form. With such an analysis once completed, however, the engineer has before him such a complete picture of existing conditions that he is able to work out to its logical conclusion the entire problem of traffic control in that particular city.

Aside from natural or rational routes drivers are apt to acquire traffic habits which turn them habitually onto congested thoroughfares. Perhaps a section of poor pavement has been responsible for diverting traffic from its natural course. Perhaps an unwise or unnecessary regulation is the responsible cause. In any case the traffic survey will reveal to the engineer the seat of the trouble and enable him to devise the steps necessary to effect the cure.

A point of serious congestion is like a cancer. The cure cannot be perma-

nently effected by any local treatment. The seat of the trouble must first be located and removed.

Once the engineer is sure of his bad spots and congested routes, once he knows where his traffic is coming from and where it is going to, he can plan and regulate in a manner that will naturally lead the driver away from unnecessary congestion with a resultant speeding up of all traffic.

The elimination of certain turns or the creation of one-way streets one block long may have the effect of turning the traffic flow into the desired lane. The citizens will probably voice their objections to any change that will cause them to modify the traffic habits of years, but in a short time the majority will discover, if the changes have been made as a result of careful study, that the new way is really better and that they are riding along faster and smoother than ever before. When this occurs all criticism will cease. The people do not object to changes that really better conditions. It is only the hastily made regulation, the change in vehicular movement undertaken without study, the prohibition that does not result in benefit that causes lasting dissatisfaction. It must be borne in mind that a hastily made ordinance designed to relieve congestion at a given point may really result in piling up a huge number of vehicles at some other bad location, perhaps a mile from the first point. Regulation of that type is not apt to make many friends for traffic control.

Any city of 50,000 population can afford a traffic survey. In fact, no city of that size can afford to get along without one. Such a survey will enable the local authorities to take immediate steps to relieve present conditions through proper regulation, and the installation of devices for the control of both vehicles and pedestrians at particularly dangerous points. A system of arterial or through traffic streets, leading from the congested or business area to the various important residential and local business centers and to the points of intersection with the principal state highway routes, will naturally become an important feature of any plan for the control of traffic. Such arterial streets must necessarily be equipped with either "stop" signs at each intersection, or else with electric traffic signals for the control of vehicles and pedestrians on all cross streets as well as on the main artery. If electric signals are decided upon, the system must be so designed that the time interval may be made to conform to the main traffic needs so as to permit a constant flow of vehicles without a stop, so long as the drivers proceed at the legally designated speed.

REMEDIES

The safe speed and the proper timing of signals can only be determined by means of the traffic survey, and the same survey is necessary in the selection of the routes to be designated.

"Stop" Signs

If "stop" signs are to be used instead of electric signals, a regulation will be needed to compel all vehicles on the cross streets to come to a full stop upon arriving at the main artery. Signs of this type are extremely dangerous unless they are strictly enforced. The through street traffic has a right to believe itself protected at each intersection from cross traffic, and, therefore, cross traffic must come to a complete stop and remain standing until the main highway can be crossed or entered without interfering with through traffic. During the morning and evening rush hours traffic officers will be needed at the principal intersections as in the absence of electric signals it might be

almost impossible for vehicles and pedestrians to cross in safety.

Prohibited Parking

In many instances the entire width of the pavement is needed to accommodate rush hour traffic. In other cases the traffic is largely directional and the entire flow side width is needed during the peak. When such a condition exists it must be met by means of rush-hour parking restrictions. Parked cars on heavy traffic arteries reduce the capacity of the street by one lane of moving cars in each direction and congestion is naturally increased by just that amount. Where traffic is directional during the peak hours a prohibition against all parking on the flow side of the street will afford an enormous measure of relief. If the movement is sufficiently dense in both directions, all parking must needs be banned during the hours of greatest density.

Pavement Lanes

It seems to be human nature for drivers to prefer the middle of the street to the right side where they belong. Naturally this tends to slow up all traffic, as the almost universal rule prohibits passing on the right, another vehicle going in the same direction. This might possibly be remedied by painting traffic lanes on the pavement; one lane for each possible line of vehicles. If drivers were required to stay in one or another of these lanes and only leave it for the purpose of passing another vehicle it would be perfectly safe to pass on either side of a car going in the same direction. A regulation giving the right of way to the vehicle nearest the right curb might have the effect of keeping drivers over in the right hand lane in order that they might maintain their right of way.

Elimination of Turns

The elimination of left hand turns and in some cases, of right hand turns, will often prove an aid in guiding traffic and relieving congestion. The elimination of all turns in the down-town shopping area where thousands of pedestrians are using the crosswalks is often resorted to as an indispensable safety measure. The left turn can be controlled and the pedestrian protected from danger. The right turn, however, cannot be controlled, inasmuch as vehicles turning to the right must pass over two crosswalks, on one of which the pedestrian has of necessity to be, when walking in obedience to the signals. The only manner in which the pedestrian can be given absolute protection against vehicles making right turns is by means of a separate interval during which all vehicular traffic is stopped. Few cities are able to afford the luxury of such a separate pedestrian interval as it invariably results in piling up traffic in a busy street to a point where it cannot be cleared on a "go" signal, without allowing such a long period of time that vehicles on the intersecting streets become hopelessly jammed. The shorter the time interval for each traffic movement, the better, but the correct timing must be determined from the data produced by the traffic survey, and must give due consideration to the varying needs of vehicle, street car and pedestrian.

Street Cars

Street cars are mass transportation and as such must be given special consideration in any study for the relief of traffic congestion. Fast, through, vehicular traffic should be led away from street car streets wherever possible and the traffic control devices on such streets should be designed to speed up street car movement to the greatest possible extent. Where electric traffic signals are used the time interval should be planned for street car operation, and electric signals on parallel streets should be timed for

motor vehicle speeds. This will have the tendency to attract vehicular traffic away from street car streets and so relieve the pressure on those streets where car tracks are installed.

Traffic control cannot be planned for the benefit of any one class, and any scheme of control that is not planned in a manner to promote the best interests of the largest number of the people, will surely fail to produce satisfactory or lasting results. Traffic officials must bear in mind the fact that most motorists are street car passengers some of the time and conversely, most street car passengers are motorists at other times.

One-way Streets

One-way streets are not popular with the general public. There is no question but that the haphazard creation of such streets is a decided detriment to all traffic movement, is an inconvenience to the riding public and a source of almost universal dissatisfaction.

On the other hand a properly laid out network of one-way streets is a distinct aid to the smooth and orderly movement of traffic. Any plan of this sort must provide for the arrangement of both one- and two-way streets in a manner to permit vehicles to proceed in the desired direction on alternate thoroughfares. Such a system will greatly simplify turning movements and will speed up traffic. Greater safety is provided for the pedestrian, as the dangerous right turn is eliminated at every other corner, and on the majority of streets traffic is only approaching from one direction so that crossings can be made with much less confusion.

It is doubtful whether two-way traffic should ever be permitted in the congested section of any city unless the streets are of a width sufficient for two moving lines of vehicles in each direction. Unless this condition exists slow moving commercial and horse-drawn vehicles will effectually block the more rapid passenger cars. The resulting congestion creates a greater measure of danger to the general public, blocks the progress of the fire department, increasing the fire hazard, and sets up an enormous annual economic loss in both time and money.

Unless such a network of one-way streets be established in congested areas it will eventually become necessary to spend millions of dollars to obtain relief by means of street widening programs in most of our large cities, and naturally the increased width of pavement will greatly add to the pedestrian hazard and will require greater annual appropriations for street maintenance.

A well layed out network of one-way streets costs practically nothing to install and maintain. If based on a careful study of local conditions it will do more to relieve congestion, guide the flow of traffic, and speed up all vehicular movement than any other single measure. The benefits are immediate and sure and the public is not inconvenienced because it is never necessary to go more than one block out of the way in order to travel in any given direction. This slight difference in distance is more than offset by the increased speed that it is possible to travel with safety.

Then, too, the creation of one-way streets usually results in splitting up the traffic by encouraging the use of different routes where at present drivers are apt to seek some particularly favored thoroughfare. The ease with which vehicles can circulate has a direct bearing on the routes selected and many drivers go out of their way to travel over some broad boulevard in order to avoid the dangers and delays always met with on narrow but more direct two-way streets.

The Parking Situation

The parking situation has a very definite bearing on traffic congestion, but it is a problem in itself and as such requires special study. It is obvious that the paved surface cannot be utilized for both operation and parking at the same time, and the question therefore is: which is of the greater importance and benefit to the community?

A great deal of unnecessary parking is by individuals who drive to business in the morning and park their cars all day. In most large cities this has resulted in local ordinances which limit the parking time and add to the existing congestion by requiring all parked cars to be moved after stated intervals. As a result the busy man must leave his work and move his car every hour or so, driving about in heavy traffic until he can locate another parking space. If he wants to go to some other part of town on business he must walk to the place where his car is parked and upon arrival at his destination he may have to drive around for ten minutes hunting for a new parking space, perhaps three or four blocks from his objective. The time lost daily by business men in this manner would furnish a fertile field for an interesting study in economics. There are, of course, numbers of people who require their cars in the daily routine of their business, but if all others could be made to realize that they cannot possibly drive their cars from the residential section to the business area of the average big city for the same price that they could make the trip for, by using mass transportation, such as is furnished by the street car and bus lines, and if they could be further made to realize that the actual money value of time lost to them during the day as a result of the parking situation was a very considerable amount, there would doubtless be an appreciable decrease in traffic congestion by reason of the number of cars that would be left at home for the family to enjoy in country and park driving.

Regulation of Pedestrians

The regulation of pedestrians is one of the most serious problems encountered in the whole scheme of traffic control. Undoubtedly Mr. Average Citizen objects to any attempt to control his method of walking on the streets. Up to the present time but few cities have accomplished an efficient method of pedestrian regulation, and it is probable that this is in a large measure responsible for the enormous and increasing numbers of pedestrian casualties. No form of pedestrian regulation should ever be proposed without very careful study, and when such a regulation has been decided upon the whole idea must be very thoroughly sold to the public before it is put into effect. Pedestrian regulation cannot be accomplished without the whole-hearted coöperation of all of the people, and any regulation that cannot be or is not enforced is bound to be a failure.

CONCLUSION

And finally, when a traffic control program has been adopted and when traffic regulations have been carefully made in accordance with the program, it is most essential that every clause be strictly enforced. No traffic regulation should ever be promulgated unless absolutely necessary in the best interests of the majority of the people and for the mutual protection of all classes and vehicles, and any ordinance that cannot be strictly enforced should be avoided. Special privileges to the favored few are fatal to the successful control of traffic and the wise administrator will see to it that the traffic regulations of his city are impartially enforced against all violators.

Uniform Traffic Signs, Signals, and Markings [1]

By M. G. Lloyd

Chief, Section of Safety Engineering, National Bureau of Standards

MODERN city traffic requires not only provision of highways which shall be suitable to handle the estimated traffic which will seek to use the city's streets, but also, for the best results, that consideration shall be given to methods of controlling traffic which are in use elsewhere. One reason for this is that, unlike olden times, much of the traffic in the streets of any city is not local but interurban, interstate, or possibly of still more distant origin. If vehicle operators are to be expected to comport themselves in conformity with local regulations and practices, those regulations and customs should be substantially uniform in all municipalities.

Modern control and regulation of street traffic, to be efficient, involves the use of such mechanical helps as traffic signals, signs and pavement markings. The use of such devices has been developing rapidly in recent years. City traffic has become so complicated and restrictions have become so numerous that it is necessary for drivers of vehicles to receive an almost continuous series of instructions not to violate regulations and thus interfere with the use of the streets by others.

The most important of the mechanical aids to traffic control are the traffic lights used at street intersections. The necessity of controlling traffic at intersections was first met by stationing a traffic officer to personally direct the movements of vehicles. To perform this function more easily he was provided with mechanical semaphore signals operated manually to stop traffic alternately upon the two intersecting thoroughfares. For use after nightfall, such apparatus was provided with lanterns of some type, the color of the light carrying the intended message. The desirability of coördinating form, color, numbering, and lettering in giving signals to an indiscriminate succession of drivers, who may include the illiterate, the deaf, and the color-blind, has been discussed elsewhere and will not be considered here.[2]

Traffic Signal Lights

The value of the automatic signal at street intersections has been sometimes questioned, and their installation should always be preceded by a traffic survey which will indicate the type of control which may be necessary. Such signals have undoubtedly been installed at places where their presence was a nuisance, and where the volume of traffic was not sufficient to warrant their use. In many places they have been of great value in avoiding confusion and accidents and in releasing traffic officers for use elsewhere. Whether their application expedites traffic will depend entirely upon the local conditions.

Where such signals are installed their choice should conform with general standards which have been based upon wide experience and a consideration of all phases of the subject, so that they

[1] Publication authorized by the Director of the Bureau of Standards of the Department of Commerce.

[2] *Traffic Signals*, by M. G. Lloyd. *Proceedings of International Association of Municipal Electricians* (1925), page 154.

will be so far as possible uniform with the practice in other cities, and thus cause as little confusion as may be to the visiting driver. For instance, there was at one time some discrepancy in the use of colors for this purpose, but this has been entirely eliminated since the standard of the American Engineering Standards Committee on this subject was drawn up and published.[3] The standard practice here is the same as upon the railroads and uses green to indicate GO; red to indicate STOP, and yellow or amber to indicate CAUTION. It is desirable to display these words upon the lens or other glass which transmits the light. Probably the majority of such installations have utilized all three of these colors, but there is a definite tendency at the present time to discard yellow unless it has some other function than that of a mere transition signal or indication of approaching change. New York, Buffalo, Salt Lake City and other cities are using simply red and green signals at intersections and find this more satisfactory owing to the general tendency of drivers to anticipate the green when they have a warning that it is about to come on. A joint committee in New York state has recommended that for this purpose red and green only be used,[4] and such a practice is in entire harmony with the standard use of colors above referred to. The yellow or amber signal when displayed between the green and red has been used for a variety of purposes such as: (a) as a warning of change; (b) to clear the intersection; (c) as a signal for left-hand turns; (d) as a signal for pedestrian traffic to move in all directions while vehicle traffic is stopped.

The purpose for which the amber light is used will determine the length of time it is displayed. Perhaps its most valuable use is for left-hand turns at intersections where such turns constitute a large part of the total traffic. The use of this color for many of the other purposes can just as well be eliminated. For example, the display of red on both thoroughfares will achieve the same purpose of stopping all vehicular traffic, and this signal is not so likely to be violated by the driver since its meaning is thoroughly understood and is likely to be considered more mandatory.

It is established standard practice not to permit the turning of corners on a red signal. Right-hand turns are usually permitted on green but the practice for left-hand turns is not so well standardized.

CONTROL OF LIGHTS

Various methods of control of traffic lights have been utilized in different cities. In some cases each intersection is individually controlled without reference to what is being done at other intersections. In other cases the controls of various intersections are synchronized so as to permit, for example, all north and south traffic to move at one time and all east and west traffic at another. In the progressive system it is planned that a vehicle traveling at a definite speed will be able to proceed along a given street so as to always encounter a green signal. Such a system, by avoiding stoppages, expedites traffic and under the conditions where it is applicable, has usually proved more satisfactory than the systems previously mentioned. A coördinated system permits the progressive scheme to be applied to an entire system of streets, with the color intervals at each

[3] *Public Roads*, 6, page 134, August, 1925; *The American City*, 33, page 241, September, 1925; *Proceedings of International Association of Municipal Electricians* 1925, page 164.

[4] *Report of Joint Committee on Traffic Control Signal Systems of the New York State Conference of Mayors and the Empire State Gas and Electric Association*, page 12 (1927).

intersection varied to suit the particular needs of that intersection.[5]

Luminous cautionary signals may be either fixed or flashing lights but should always be yellow in color. When some specific message or instruction is to be given it can usually be placed in lettering upon the supporting pedestal and illuminated by light thrown downward from the lamp.

NONLUMINOUS SIGNS

Consideration of nonluminous signs leads us into a field where standardization has not been so widely applied but is very urgently needed. Drivers frequently have difficulty in perceiving the message upon a painted sign during the short interval of time in which it has their attention. Every effort should be made consequently by the use of form, color, symbols and a minimum of bold lettering to render the message ascertainable at a glance.

The Joint Board on Interstate Highways has worked out a system of painted signs which has many meritorious features and which has been accepted by the American Association of State Highway Officials.[6]

This system will be largely applied upon state highways throughout the country and especially upon those receiving federal aid. They are to a large extent applicable also for municipal purposes. Three fundamental features of these signs are shape, color and lettering. While sizes have been standardized for rural use, this feature may need modification for urban purposes.

[5] A discussion of these systems and of other features of traffic signals, such as location, method of mounting, is given in the *New York State Report* previously referred to.

[6] *See Manual and Specifications for the Manufacture, Display and Erection of U. S. Standard Road Markers and Signs* (January, 1927), prepared by U. S. Bureau of Public Roads.

SHAPE OF SIGNS

Rectangular signs are used to carry directions, information, and restrictions.

Square signs are used to indicate a condition requiring caution that is not inherent in the road itself but due to conditions which may be intermittent and which arise from the presence of cross-roads, buildings, or other objects.

The circular sign is used as an advance warning of approach to a railroad grade crossing.

Diamond signs are used to indicate a condition requiring caution and restricted speed which is inherent in the road itself.

Octagonal signs are used to indicate that a stop is necessary.

A sign in the shape of a shield is used as a through-route marker.

COLOR OF SIGNS

All directional, informational and restrictive signs, including route markers, carry black lettering on a white background.

All cautionary signs carry black lettering upon a yellow background.

Regarding a stop sign as indicating the highest degree of caution, the Board has recommended that the stop sign also carry black lettering upon a yellow background. Such a sign is being installed to some extent upon state highways, but since there is little occasion for such a message in such locations it has found but slight application in this form. The principal uses for a stop sign are:

1. Dead-end streets.
2. Intersections with arterial highways.
3. Grade crossings of railroads.
4. One-way or closed streets (detours).

The first two of these occur mainly in cities and for the last a stop sign is seldom used as the condition may be only temporary. The control of grade crossings is usually in the hands of the public utilities commission rather than the state highway official. While there are some arterial signs outside of municipal limits, the principal application of signs in this connection will be within municipalities. It appears then that the placing of stop signs will be largely covered by municipal officials and by public utility or railroad commissions, and in these quarters there is a strong opinion that red rather than yellow should be used for a stop sign. A number of cities are already using a red octagonal sign for this purpose, but at this writing no standard can be considered as fixed for this purpose.

Examples of yellow, diamond-shape, cautionary signs are those used to indicate sharp curves and steep hills. (See Figure 1.)

Examples of square, yellow signs are those indicating the approach to crossroads, schools and hospitals. (See Figure 2.)

Examples of rectangular signs in black and white are those stating speed limits, geographic location, directions and distances. (See Figure 3.)

Where symbols having unmistakable meaning can be used, they are preferable to words alone. Figure 4 shows the symbols recommended by the committee which prepared the A. E. S. C. standard.

FIGURE 1. SAMPLE OF DIAMOND-SHAPE CAUTIONARY SIGN
Black lettering on yellow background

REFLECTING SIGNS

A definite field of usefulness appears to be open to the reflecting sign, that is, one which carries plain or colored glass which reflects the light from automobile headlamps to the automobile driver. This glass may be yellow or red to convey the message indicated by those colors, or white glass in the form of lettering may be mounted on a sign which is painted to give a background of the appropriate color. For example, one form of such a sign reflects the letters STOP from a

FIGURE 2. SAMPLE OF SQUARE CAUTIONARY SIGN
Black lettering on yellow background

sign with red background. In another form the body of the sign consists of red reflective glass, no wording being applied.

PAVEMENT MARKINGS

The use of pavement and curb markings has not reached as high a degree of standardization as the use of signs and luminous signals. The principal forms of surface markings which have been tried are paint, canvas, and inserts of metal, rubber, or paving material. Projecting buttons, either illuminated or non-illuminated, have been tried out in many cities, but owing to the damage caused to themselves and to vehicles from the impact resulting from cars running over them which is to a certain extent inevitable, they are not at present in very high favor.

Surface markings serve a variety of useful purposes. Lines are used for marking the center of the highway, traffic lanes, cross walks, safety zones, parking stalls, etc. Lettering may be used for various purposes such as traffic directions, cautionary warnings, and

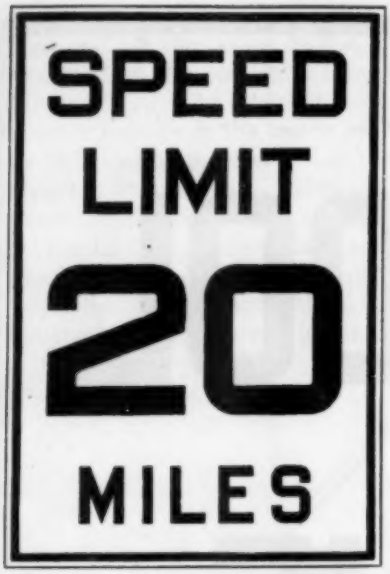


FIGURE 3. SAMPLE OF RECTANGULAR RESTRICTIVE SIGN
Black lettering on white background

parking instructions. Raised buttons have been principally used at street intersections and to mark safety or car-loading zones.

The type of marking employed will depend largely upon the type of pavement. Paint is satisfactory on concrete, wood blocks, and to a lesser extent upon bituminous surfaces and others. Canvas can be applied to any smooth surface. Inserts are largely in the experimental stage and the particular type used will largely depend upon the kind of pavement. Where the pavement material shifts easily, as in the case of asphalt, there are disadvantages with nearly all types of markings.

Painted lines may be from four to eight inches wide. When used to mark center lines on straight runs of concrete, they are preferably black in color, white being reserved for curves, hills and other places where the line is not to be crossed. Yellow has also been advocated for the latter purpose. Where painted lines are much driven over, as in the case of cross walks, frequent renewal will be necessary. On curbs and other places where it does not receive this wear a durable paint will last for many months. The selection of a suitable paint for the purpose is of great importance in reducing maintenance cost, and experiments are now being conducted at the Bureau of Standards for the purpose of obtaining comparative data regarding different paint materials.

In considering the use of inserts in the surface of the roadway, it must be remembered that the introduction of a material having properties different from the roadway surface itself necessarily involves unequal wear, and is likely to eventually result in depressions or hard spots in the roadway surface which may result in unevenness and damage to the inserts themselves.

Where lettering is applied to the road surface it should be in large letters and brief in extent. Such lettering is in the field of view of the driver for a very short time and is viewed from an unfavorable angle, so that it is not possible for him to give the attention which is necessary if more than one or two short words are to be read. Distortion of the letters in the plane of the street, so as to appear more nearly normal at the angle of the approaching driver, has been suggested but as yet little used. The size of letters will depend upon the prevailing speed at the place where they are used.

Safety zones which are only indicated by pavement markings are sometimes difficult to perceive at night; and to be entirely safe it seems necessary to use a raised platform with appropriate illumination and cautionary lights. These lights in the accepted scheme are yellow, not red, and

there should be at least two lamps used, so that a single burn-out of a lamp will not leave the obstruction in darkness. This statement is also applicable to the mushroom buttons, where they are used.

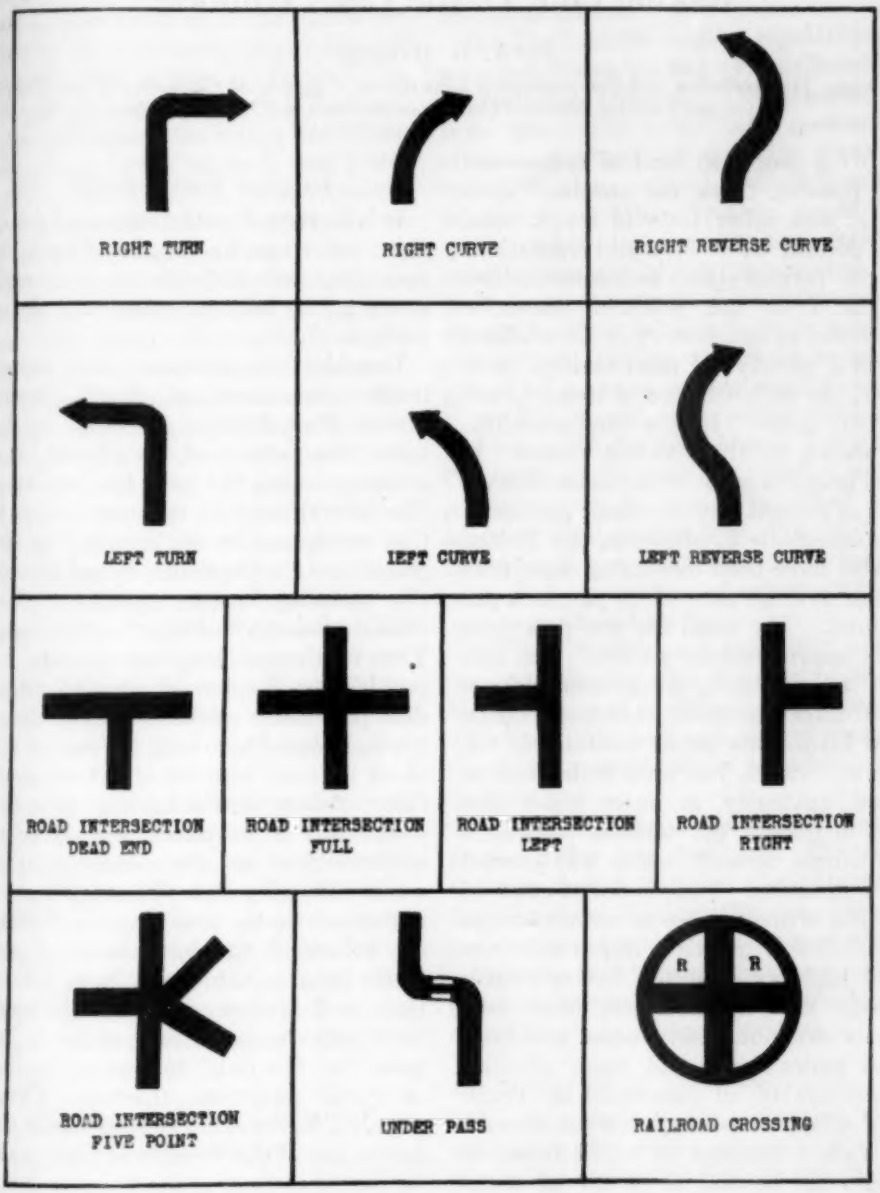


FIGURE 4. RECOMMENDED SYMBOLS FOR HIGHWAY TRAFFIC SIGNS OF A CAUTIONARY NATURE
Black on yellow background

Making Our Traffic Laws Uniform

By A. B. Barber

Manager, Transportation and Communication Department, Chamber of Commerce of the United States, and Director, National Conference on Street and Highway Safety

TO a people so fond of cross word puzzles, "Ask me another" contests, and other tests of quick wits, our present traffic laws and regulations in the various states and communities might, from one point of view, be regarded as satisfactory. They afford endless variety. Unfortunately, however, the motor traffic of today is not a mere game. It is a deadly reality, as shown by the accident record. It also presents some of the most difficult of our present-day economic problems.

Automobile fatalities in the United States have been increasing since 1920 at an average rate of 10 per cent per annum. The total for the past year was approximately 25,000. The loss due to accidents, congestion, delays, and other results of ill-ordered traffic and inadequate traffic facilities in the United States, has been estimated on good authority at more than two billion dollars per annum. There is no single remedy which will correct this situation. Improvement must be sought in many different ways: through legislation, regulation, improved street and highway facilities, better vehicle design and maintenance, more adequate discipline and control of drivers and pedestrians, and more effective education of all concerned in traffic and safety measures. No one element in such a program of traffic improvement can be said to be the most important, but there seems to be general agreement that none is more important than the standardization of our essential traffic laws and regulations.

Lack of Uniformity

It is in regard to the rules and practices affecting the details of vehicle operation that divergencies are most striking. A few examples may be of interest.

Consider, for instance, the motor traffic phenomena of South Broad Street, Philadelphia, as they might have been observed on almost any evening during the past few months.[1] The prevailing rule in many cities is that turns may be made only "on the green light." On South Broad Street, the motorist has to remember that Philadelphia traffic turns "on the red." The visiting motorist may also be puzzled by the curved lines of metal disc pavement markers leading from the right-hand curb near the end of the block leftward into the street intersection. Before these markings, near the center line of the street, is painted in white letters on the pavement the word "Stop." But the traffic does not stop. In the main it goes directly on, following the indications of the traffic lights. Some cars, from time to time, pull up alongside the right-hand curb and ultimately accomplish a left turn "on the red," following the line of metal pavement markers. Occasionally, however, cars stop along the center line of the street, and then make

[1] Since the above was written, information has been received indicating that Philadelphia is about to make certain changes in her traffic rules to bring them into closer harmony with prevailing practices.

the left turn, sometimes on the red, sometimes on the green. Traffic is heavy, and there is clearly confusion and an element of danger here.

The explanation is furnished by a traffic officer standing on the far corner of the street at a booth from which he operates the signals. "Those," he said, pointing to two cars that had just stopped alongside the center line of the street, "are New York cars; that is the way they make the left turns up there. We don't bother them, but sometimes we have to straighten them out when they get confused. Philadelphia," he continued, "has the finest traffic system in the country, but we really ought to have the same system everywhere."

In some communities a sign is attached to each traffic light, explaining what system is in force at the particular intersection, such as "Turn on green," "Right turns only on green," "Turn on red," etc. While such signs are of some assistance, it requires more than ordinary ability, under conditions of heavy traffic, at one and the same time to read and interpret the signs correctly, follow the indications of the signals, and observe the necessary care with regard to other traffic and pedestrians.

There are scores of other points with regard to which the traffic rules and practices present such wide variety as to produce definite hazard and confusion. Some of these are obvious, for example, location of signals, the use of color for different indications, etc. Other differences are less obvious, but probably more serious, particularly in the right of way rules.

EARLIER EFFORTS TOWARDS UNIFORMITY

Notable advances have been made during the past ten years in the development of our traffic laws and practices, through the efforts of the responsible state and local authorities. In this work they have had assistance from several national bodies and particularly from model laws and regulations drawn up by several different groups as follows:

(a) The model traffic regulations prepared during the war by the Council of National Defense. These regulations were very useful, and portions of them were embodied in the traffic rules of many cities. Being based primarily on the "rotary traffic" system which has recently to a large extent given way to the "stop and go" or "platoon" system of traffic movement, these regulations have in most places been largely added to or replaced by more up to date regulations.

(b) The model state motor vehicle law proposed by the Motor Vehicle Conference Committee. While not purporting to be complete either in scope or legal phraseology, this model law served an extremely useful purpose, many provisions of existing state laws being based on it.

(c) The model auto anti-theft act, prepared shortly after the war by the National Board of Fire Underwriters. This has also served as a general model for existing certificate of title laws in many states.

(d) Other model codes, such as those prepared by the American Electric Railway Association and the National Association of Taxicab Owners. These have received attention of responsible authorities in various localities and furnished the basis of certain provisions of existing laws and regulations.

SITUATION IN VARIOUS STATES

In considering the situation in different parts of the country, attention will be directed first to the state motor vehicle laws, and afterwards to the municipal ordinances and regulations.

The motor vehicle laws, while not always so divided, may for convenience be considered in four parts: (1) Registration and administration; (2) certificate of title or anti-theft provisions; (3) licensing of operators and chauffeurs; (4) rules of the road and other regulations governing vehicle operation.

In general, the North Atlantic states and California have the most advanced automobile laws. They have, with a few exceptions, licensing systems, including examination, which are proving of the greatest value. The accident hazard in the cities of these states is, according to a recent study, 25 per cent to 30 per cent less on the average than in the states which have not established modern systems of motor vehicle administration. They have generally similar systems with a single responsible "Motor Vehicle Administration" or "Registrar of Motor Vehicles" for each state, who administers the registration and licensing of both vehicles and operators, determines technical requirements as to vehicle equipment, keeps the records, and makes the investigations of accidents, and in most cases has a certain responsibility for the discipline of drivers with power of revocation or suspension of licenses. The heads of the motor vehicle department of the northeastern states have organized an "Eastern Conference of Motor Vehicle Administrators" which has accomplished much in such matters as unification of headlight requirements, interchange of information on registrations, stolen cars and operators' licenses revoked for cause, and a wide range of related subjects.

Unfortunately, in spite of some recent progress, there is still a considerable degree of divergence among the northeastern states in their rules of the road and other laws governing vehicle operation. Also several of these states are conspicuous by their lack of certificate of title or auto anti-theft laws. When they have achieved a greater degree of uniformity in these respects and in municipal regulations (which will be discussed later in this paper), their traffic records should show marked improvement.

WESTERN AND SOUTHERN STATES

Prior to the 1927 sessions of their legislatures, most of the states south of Virginia and west of the Alleghenies had very incomplete and diverse traffic laws and inadequate motor vehicle departments. Only four or five had drivers' licensing systems, and none of these required an examination as a prerequisite to the issuance of a license. Michigan, for example, has licenses issued by local officials, and the system is recognized as an unsatisfactory half measure.

In general, these western and southern states do not have separate automobile departments or motor vehicle bureaus. The work done is mainly that incident to registration of motor vehicles (in a few states also certification of title), and this is usually assigned to the Highway Department, the Secretary of State, the Commissioner of Licenses, or, in the case of Montana, the Warden of the State Penitentiary. Recently, an informal conference was formed among the officials handling automobile matters in a number of middle-western states—Indiana, Illinois, Wisconsin, Iowa, Minnesota and North Dakota—but due to the incompleteness of the state laws, the scope of this conference is less than that of the Eastern Conference.

In anti-theft work, through the certification of title laws, considerable progress has been made, as is shown by the data reported by the National Automobile Dealers Association, from which it appears that in 1921, with eight states representing 20 per cent

of the United States' population having certification laws, 29 per cent of the stolen motor vehicles remained unrecovered, whereas in 1926, with twenty-five states and fifty-two per cent of the population benefiting by such laws, only 11 per cent of stolen cars failed to be recovered. Unfortunately, the certification laws in a number of states omitted important features of the model law on this subject, and, together with the lack of any such laws in the remaining states, leave loopholes which make the present system less effective than if it were established on a nation-wide substantially uniform basis.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY

Early in 1924, Secretary of Commerce Hoover, with the coöperation of some ten national associations interested in street and highway traffic, organized a conference to study and make such recommendations as might be practicable for dealing with the automobile traffic and accident problem. In the reports of its eight committees and in the first general conference, which was held in December, 1924, great stress was laid upon the need for uniformity in traffic laws, regulations, and practices. There had been a suggestion from some quarters that the problem of uniformity should be settled once for all by assumption of jurisdiction by the federal government and the enactment of a national traffic law. But this suggestion was rejected, and the First Conference contented itself with adoption of a comprehensive statement of principles recommended for inclusion in state traffic laws and regulations throughout the country.

DEMAND FOR FORMULATION OF A UNIFORM VEHICLE CODE

Soon, however, it developed that a statement of principles was not enough. A widespread demand arose for material in definite legal form for presentation to the legislatures. At the request of the national associations and other official and unofficial groups participating in the conference, a Committee on Uniformity of Laws and Regulations was appointed by Secretary Hoover in March, 1925, to draft a Uniform Vehicle Act or Code.

For many years the question of uniformity in the state motor vehicle laws had been under consideration by the National Conference of Commissioners on Uniform State Laws, an official body of delegates appointed by the governors of the states to promote uniformity in state legislation. Up to 1924, the prevailing opinion in that conference had been that the time was not yet ripe to prepare a uniform vehicle act for adoption by the states. In that year, however, the Commissioners on Uniform State Laws decided to undertake the preparation of such an act. Accordingly, when the National Conference on Street and Highway Safety determined upon the same objective, coöperation with the commissioners was arranged. The president of the Commissioners on Uniform State Laws was appointed as chairman, and several other commissioners as members of the National Conference on Street and Highway Safety Committee on Uniformity of Laws and Regulations, which also included leading representatives of the branches of state and local government concerned, the principal industries or lines of business affected, and the general public.

PREPARATION OF PROPOSED UNIFORM ACTS

In its work this committee had the benefit of a complete tabulation and comparison of all the motor vehicle laws of all the states. The act (or code of four acts as finally drawn up)

was prepared with the most thorough study. Several successive preliminary drafts worked out by the Committee were widely distributed for scrutiny and criticism by all parties interested, including organizations, associations, motor clubs, safety councils, chambers of commerce, public officials and others, each draft being revised in the light of the comments received. Finally the report of the committee and the proposed uniform code were submitted to and considered by a plenary session of the National Conference on Street and Highway Safety held in Washington, March 23, 24, 25, 1926, attended by more than 1000 delegates from all parts of the country, including official delegations appointed by the governors of 43 states on the invitation of President Coolidge.

In accordance with the instructions of the conference, certain further modifications of the acts were later made and in July, 1926, the proposed code was adopted by the National Conference of Commissioners on Uniform State Laws and endorsed by the American Bar Association. Since then it has been endorsed by a number of other associations or groups.

This code consists of four acts as follows:

(1) A uniform motor vehicle registration act, which includes also important provisions for the reporting of accidents, administration of the motor vehicle department or bureau, collection of accident statistics and regulation of for-rent-cars without drivers.

(2) A uniform motor vehicle anti-theft act, providing for issuance of certificates of title, maintenance in each state of central registry of motor vehicles against which any new registration applications must be checked, and other anti-theft provisions.

(3) A uniform motor vehicle operators' and chauffeurs' license act prescribing qualifications and examination required for drivers' licenses, and providing for suspension or revocation under certain conditions.

(4) A uniform act regulating the operation of vehicles on highways, prescribing rules of the road, speed, limits, size, weight and equipment of vehicles, and rules against reckless driving or driving while intoxicated.

ACTION BY STATE LEGISLATURES, 1927

During the legislative session of 1927, California adopted additional provisions, including those for mandatory examination for drivers' license, thus bringing the California laws into practically complete harmony with the Uniform Vehicle Code.

Pennsylvania embodied in a single act virtually the entire Uniform Vehicle Code, repealing all existing legislation inconsistent therewith.

North Carolina, North Dakota and Idaho adopted laws closely conforming to Acts I, II and IV of the Uniform Code, that is, the registration, anti-theft and vehicle operation acts.

Michigan, Minnesota and Washington adopted new laws based closely on Act IV, of the Uniform Code, that is, the vehicle operation or rules of the road act.

Delaware, Florida, Maine, New Hampshire, New Jersey, Oklahoma, Oregon, and Rhode Island passed supplementary bills which brought their laws into closer harmony with the Uniform Code, especially with the fourth or vehicle operation act.

Arkansas, by administrative order, promulgated traffic rules and regulations in general harmony with the Code.

In four states, Kansas, Missouri, Ohio and Utah, legislation based on the Uniform Code made definite progress, being passed by one or the other of the two houses of the respective legislatures but failed of final adoption.

Several legislatures are still in session and in addition, several states have not been definitely heard from up to the present time as to progress made.

On the whole, the progress made toward uniformity of essential state motor vehicle laws during 1927 was very notable. During 1928 relatively few legislatures will meet, but included among them are at least four which did not hold regular sessions in 1927, *i.e.* Virginia, Kentucky, Mississippi, and Louisiana. In 1929, however, more than forty legislatures are to meet, and that year promises to be an important one in regard to traffic legislation.

MUNICIPAL ORDINANCES AND REGULATIONS

The next step needed is a move for securing greater uniformity among the traffic ordinances and regulations of the various cities and towns throughout the country, as supplementary to the uniform state laws. Even where the laws of the states are reasonably similar it is found that the ordinances and regulations of cities and towns differ widely. Efforts have been made in some states, notably California and Michigan, to prepare and secure adoption of a model municipal traffic ordinance within each state. More than 200 Michigan cities and towns have adopted the Michigan ordinance. Unfortunately, however, even the California and Michigan ordinances show material differences. Other model ordinances such as those of Minnesota and Colorado show additional discrepancies.

At the suggestion of a number of the associations which participated in the National Conference on Street and Highway Safety, Secretary Hoover has just appointed a committee, with nation-wide representation of all interests affected, to study the traffic problem of the cities and towns, and to make such suggestions as may be practicable with a view to furthering uniformity in municipal traffic ordinances. William E. Metzger of Detroit is serving as chairman of the general committee for this purpose, and the study is being divided into six subjects as follows:

1. Vehicle movement and regulation;
2. Pedestrian facilities and regulation;
3. Traffic signs, signals and markings;
4. Parking, terminals, garages, loading facilities and street obstructions;
5. Public motor vehicles, street cars, railways, and emergency vehicles;
6. Traffic organization and enforcement.

Each of these subjects has been assigned to a committee, which, in addition to studying the ordinances of all the larger cities and towns, and proposing so far as may be practicable recommendations for a model ordinance for general use, will also render factual reports with regard to the subjects indicated.

It is, of course, recognized that the same provisions will not in every case be suitable for all communities, and it is expected that the suggested ordinance and regulations will include a number of alternate provisions. In other words, any recommendations made will be so flexible that they may be readily worked out to suit local conditions.

The ultimate objective is, of course, to secure such reasonable degree of uniformity in state laws, city ordinances, and driving practices as to remove the great confusion and uncertainty which now exists, and to bring about the day when the motorist outside of his home district will no longer be in imminent danger of accident or arrest, due to the confusion of our traffic.

New Speed Laws for a New Era

By A. J. Brosseau
President, Mack Trucks Inc.

MANY an old proverb might today well be rewritten to express the motor age. A particularly apt revision would be the substitution of the word "congestion" for "procrastination" as the thief of time.

While congestion is a somewhat all-inclusive term, its net meaning is the same as that of the older word—loss of time.

What are some of the causes of congestion?

Inadequate Traffic Facilities

Inadequate facilities, or inadequate use of present facilities will almost universally answer the question. But more facts are needed. And having the facts, administrative officials must have the support of the public in acting upon them.

The report of the coöperative survey conducted by the U. S. Bureau of Public Roads and the Cook County Highway Commission in the Chicago Area in 1925 states:

> Highway traffic in sections of the county, particularly the zone surrounding the city of Chicago, already exceeds the functional capacity of the improved routes in these sections; and the great increase in traffic that may be expected during the next five years indicates that unless a comprehensive betterment program is initiated and substantially completed within this period the county and the city of Chicago will suffer seriously from the lack of adequate highway facilities.

Substitute any county in which is located any of the larger cities of this country and a replica is obtained of the picture here presented.

Before this article appears in print, there will have been tried out on the streets and highways of this country, a device perfected by the United States Bureau of Public Roads and designed to measure the causes and effects of congestion.

It is simply a space-time recorder. On the tape will be recorded the cause of congestion, waits at street highway and rail intersections, slow-moving vehicles, street and highway obstructions, and the innumerable other causes all summed up in the one word—congestion.

At the same time there will be recorded on the tape the time consumed at each point and the causes. Thus the result—lost time—will be set down incontrovertibly in black and white. From this basis the student may investigate as far as he wishes into increased operating expenses of the vehicle, due to the long delays in deliveries of merchandise and passengers and other items.

Where Is Congestion Today?

Probably most persons driving a car today would say that congestion is found everywhere, whether on the country road, in the small town or in the metropolis. Unquestionably, however, the cities face the severest problem.

How serious this may be to population centers of all kinds is evidenced from surveys of the United States Bureau of Public Roads, which show the percentage of cars originating in the city and using main rural highways. The figures for four states are:

	Per Cent
Pennsylvania (primary system only)	94
Ohio	87.6
New Hampshire	93.9
Vermont	89.8

Terminal Areas Present Acute Situation

Congestion in the city proper presents a problem in itself, the question of the parked vehicle, space for the vehicles moving intra-city, from downtown sections to suburban and vice versa, one way streets, street widening, closer coördination between city administrative departments, and any number of other questions.

Lack of good terminal facilities for the receiving and dispatching of this vast volume of traffic is a problem to be settled within the city, in many cases the working out of the difficulties depending on peculiar local conditions.

In the present discussion I should like to indicate some of the phases of congestion outside the city proper, but which, nevertheless, are inseparably linked with the city problem and which present universally fundamental principles.

By-passing Aid to Inter-City Traffic

Much of the traffic congestion difficulty experienced by the large city and an even larger percentage of the small town's trouble in this respect comes from the constant dumping into them of through traffic, most of which has no desire to go through the city or town, and would not do so if there were any alternative.

Baltimore will illustrate the point. The main road from Washington to Philadelphia and New York goes through the heart of Baltimore. I daresay but a small portion of through traffic between Washington and Philadelphia has any desire to pass through the city traffic. At the same time I am equally sure that Baltimore drivers would be delighted to have traffic conditions eased up to the extent of lessening the minimum number of strange drivers on the streets.

By-pass roads should and are being developed rapidly to divert through traffic around population centers. At the same time a choice of direction is offered the traveler and he may go into the town or city if he wishes.

Excellent examples of by-pass roads are found in Illinois. The main highway from Chicago to East St. Louis is one of the finest illustrations of the value of by-passing. Sixteen towns are by-passed in the course of the 303 miles of this road's length.

To the small town this may seem like a blessing in disguise but all too many of them install traffic control lights, add officers to the city tax roll and still wail about their traffic conditions, when by the simple expedient of diverting through traffic from their streets these facilities would revert to a more normal use for the adjacent population.

Study of State Systems Needed

In many instances the overloading of certain main highway routes can be relieved through the development of parallel or substitute routes. What may be accomplished in this respect is forcefully presented in a report prepared by Major W. G. Sloan, Chief Engineer of the New Jersey State Highway Commission, with reference to the proposal to increase the state system mileage.

Here by means of development of back routes, improvement of little used roads and linking them up to the main routes at critical separation points, traffic from New York and the northern part of New Jersey bound for points on the coast in southern New Jersey will have an almost clear run with few intersections of any kind and practically no towns or cities. Innumerable

small towns along the coast, with narrow streets and inadequate facilities for handling the flood of traffic increasing monthly, would be relieved of an unnecessary burden.

Result of Peak Demands

Very few of our modern rural highways are congested except over week-ends. It is only in getting out of the city to them that difficulty is experienced, largely because of inadequate facilities for reaching "main lines."

Prior to the days of the motor vehicle, most of the traffic flowed toward the city, concentrating as it neared the city. Today the converse situation pertains. The city is the reservoir from which the traffic originates, all too often converging early on one or two thoroughfares for the exit from the city. This same traffic on its return, "floods" the narrow channels available at the city limits and often earlier, causing tie-ups and delays to all.

What we need to do apparently is to turn the river around. Figures 1 and 2 illustrate this point.

A proper balance must be struck, of course, in determining the extent to which the peak demand can economically be met in the provision of additional and oftimes expensive facilities.

Facilities at Hand but Undeveloped

Here again, however, nearly every city already has potential facilities at hand, both to increase its normal traffic capacity and to go far in meeting peak demands. Generally there are available a sufficient number of parallel streets and potential traffic channels that are not used simply because of gaps—a few unpaved blocks—unnecessarily round-about streets which could be straightened out at comparatively small expense—and other obstructions which should be removed. Peak demands can thus frequently be met without the tremendous financial outlays at first appearing to be necessary.

Another excerpt from the Cook County Highway Survey gives point to the foregoing:

> Approximately 35 per cent of the traffic using the Western Avenue entrance to the city could more directly use Halsted Street if it provided a suitable route to the center of the city. Traffic prefers to detour four miles and use Western Avenue rather than enter via Halsted Street. Assuming that

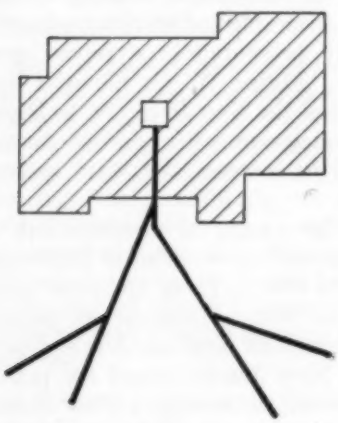


FIGURE 1
Showing Concentration that Breeds Congestion

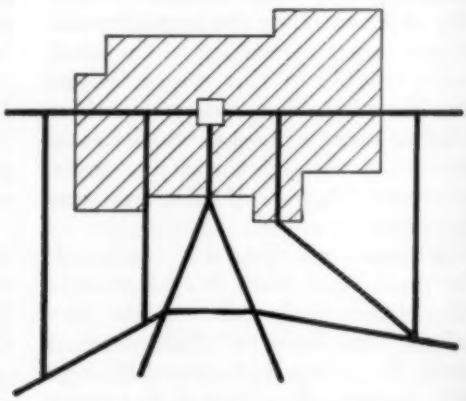


FIGURE 2
Proper Distribution of Traffic

35 per cent of the traffic on Western Avenue detours four miles the result is a total of approximately 21,000 additional vehicle miles daily; a daily cost of 10 cents per vehicle mile, of $2,100; a yearly total (300 day year) of $630,000. It *should be clear from these figures that it is cheaper to remedy than to ignore obstacles to the free movement of traffic.*

Belt Line Highways Aid

In many cities belt line highways or boulevards have proven of tremendous assistance in the distribution and concentration of traffic. Detroit, with her Grand Boulevard, formerly out in the country, and now carrying a tremendous volume of cross-town and intra-city traffic, is an example. Farther out her five-mile, six-mile and seven-mile roads are concentric rings which have the effect of breaking up traffic at the outskirts of the city or conversely, of concentrating it well out of the city proper. (See Figure 3)

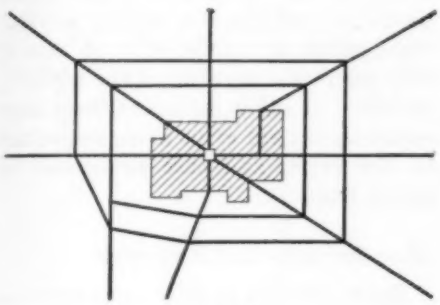


FIGURE 3

SOLUTIONS FOR THE FUTURE

Crossing Traffic Problem

At junction points where traffic joins the main stream or where vehicles wish to change direction there is a focal point of congestion. Two solutions appear to be effective as a means of handling efficiently and safely a continuous flow of traffic.

Both solutions require a considerable area for their execution, but the former is by far the less expensive.

In London the rotary principle of handling traffic at some intersections is a demonstrated success. Some cities of the United States have examples of this, notably Washington, D. C., with its famous circles named for noted generals. Traffic here flows as indicated in Figure 4.

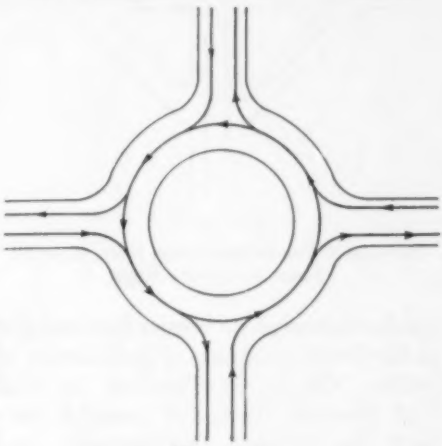


FIGURE 4

Rotary Type Traffic Intersection

This type of traffic intersection will undoubtedly be the more generally adopted at main highway crossings, because in so many cases the largest volume of traffic is carried on one route. Where traffic is exceptionally heavy on both routes, however, grade separation—costly as it is—seems to be the best solution. We have concrete illustrations of its effectiveness at the present time in the Bronx Parkway in Westchester County, N. Y.

Provision must be made of course, for turning from one main road to the other, at points of such separation, such turns not to cross traffic.

This involves traffic handling as indicated in Figure 5.

Metropolitan Areas

The rapid growth of suburban communities toward cities or conversely the expansion of the city to include the

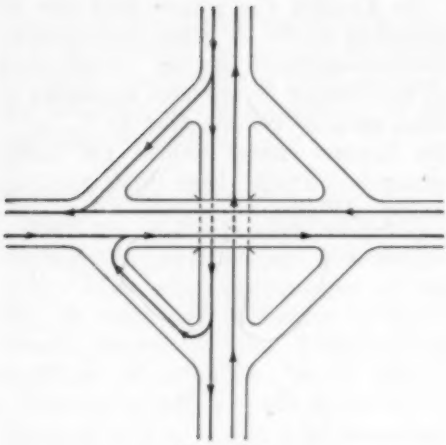


FIGURE 5

Because of Grade Separation Note How All Turns Are to the Right

smaller towns at its border has brought to the front questions of jurisdiction of traffic. Closer coördination is vital that through lines and parallel lines may be utilized continuously and effectively.

Super-Highways or Parallel Highways

There are today vigorous proponents of the super-highway and equally vigorous advocates of parallel road building. Engineering opinion, however, goes into the facts in each instance. The data so far advanced seem to indicate that the super-highway for the carrying of all types of traffic, segregated by lanes, is most effective where the traffic service is needed throughout the greater part of its route.

On the other hand, where population is quite evenly distributed and there are back-lying sections in need of equally good highway service, or where there is little preference in volume of traffic to be served, then the parallel road undoubtedly should be developed. Here, again, we will probably find traffic segregation, not by roads as has been suggested many times, but by lanes.

The reason for this is quite obvious. All types of vehicles are going to practically the same places because highway transportation service is composed of all types of vehicles. Just as on the city boulevard the homes there must be served by grocery delivery wagons, coal and ice and perhaps motor bus, so all our highways must be kept available for all types of service.

Minimum Speed Limits Future Necessity

We now think of our highway traffic in terms of maximum speed limits. Equally important, I believe, is the consideration of minimum speed limits. It is essential that the point of maximum volume be discovered and studies made with a view to moving traffic at a speed that will produce the highest possible average rate of traffic flow. To this end a minimum speed limit will be as necessary as maximum speed limits and enforcement equally as vital. Segregation of traffic will, of course, help where the capacity of the highway permits—in other instances these minimum limits are even more important to the rapid and safe movement of mixed traffic.

More Intensive Use Necessary

Even today it is quite apparent to a close observer that we are by no means realizing the maximum efficiency from our highways.

Not only is traffic careless in use of street and highway space, so that the roadway is but partially utilized, but in point of time we are leaving unused a tremendous investment.

At some points—for instance, between Philadelphia and New York were one to drive the route at night, one would find large fleets of commercial vehicles making nightly trips with perishable or high value merchandise

for delivery at either of these two points in a period of time not possible to equal by rail.

Certainly there will be in the future a more complete use of the road for the full twenty-four hours of the day, but only as we apply our engineering knowledge to solving the problems of congestion and the provision of adequate facilities.

Equipment and Control of the Motor Vehicle

By David Beecroft
Vice-President, *Chilton Class Journal* Company

PLANNING for city traffic should have among its major considerations: first, securing the maximum use of the streets for all types of vehicles and pedestrians; second, aiming to secure the maximum safety for all of these users; and third, securing the maximum use and maximum safety, with the minimum consumption of mental and physical energy of all the users of the streets.

The third consideration, conserving the mental and physical energy of those using the streets, is in reality of first importance, in that it is a very direct influence in securing maximum use of the streets with maximum safety to all concerned. The fact that the number of street accidents in our cities peaks between four and six o'clock each afternoon, reaching the apex at approximately five o'clock, is a matter of keen interest as studies may show that this peaking of accidents is not entirely due to the increased volume of traffic, but rather to the fact that the mental alertness of the users is not so acute as in the morning peak; and further the tax on the physical energy during the day may have been such as to be classed, along with the tax on the mental energy, as a contributing factor to the high accident rate.

If the conservation of the physical and mental energy of all street users, drivers of motor vehicles, operators of all other types of vehicles, and pedestrians as well, is constantly in the consciousness of those who have the welfare of future traffic at heart, many false steps will be avoided and a nearer approach to the straight line of improvement will be obtained.

The importance of a broad consideration of all pertinent factors relating to traffic is most essential today in the forming of any and all plans for the future of our cities, because of the rapid increase in the number of motor vehicles and the necessity for speeding up traffic in every way possible, but speeding it up without a single iota of needless sacrifice of safety.

Present Facts Inadequate

Up to this time the various studies of accidents, or at least the reports of such studies, have not indicated a sufficient thoroughness in the examination into the details of the various causes of accidents. For example: In some states 40 per cent of the accidents occur at street or highway intersections which points invariably are centers of confusion, but there is a lack of information as to what was the specific factor that contributed most to the accident, namely, inadequate traffic regulation, mental confusion of pedestrian, mental confusion of vehicle operator, partial obstruction of operator's vision due to vehicle design, poor marking of street crossing, too high speed of vehicle, too narrow streets, obscured corners, inadequate street lighting, unnecessary noise, or any one of several other possible contributing factors.

If an accident analysis were more complete the information of such would be of almost inestimable value in the consideration of plans for the future, whether those plans related to the ve-

hicle, the streets, the speed, the pedestrians, traffic signals, street lighting or other contributing factors.

Such information, from different cities, would be of first importance, when the consideration of the equipment of the motor vehicle is concerned, for every regulation concerning motor vehicle equipment would be based on broad and fairly well-established facts and not on theory or the whims of a few. It is possible to secure, perhaps within a year, from possibly one hundred different cities, sufficient facts concerning accidents that would be of greatest value, but not enough is being done at present.

PROGRESS IN CONTROL

What is being done to conserve the mental and physical energies of the operators of motor vehicles and what still remains to be done?

At the outset, it is apparent that such a problem includes not only the equipment of a motor vehicle but equal care with regard to influencing factors that are outside of, and apart from, the vehicle.

Great progress has been made in the motor vehicle to conserve both the physical and mental energies of the operators, and a hasty review of these is pertinent. The lower-pressure tires have made vehicles easier riding and quieter, thereby conserving energy. Gear shift positions are nearly all standardized, so that gear changing motions are as near automatic as possible and call for a minimum physical and mental effort. The operation of the clutch calls for immeasurably less foot pressure than was needed a few years ago. The application of brakes on several cars still calls for too much foot pressure, and we will unquestionably copy Europe more and more in the use of the power-applied, or servo-brake as it is designated, solely because it conserves the physical energy of the driver, and thereby is a contributing factor to the more efficient use of our streets with greater safety as well. Steering with balloon type tires has been improved so that now the effort required is no greater, and frequently less, than with the old high-pressure tires, although the steering wheel has to be turned more to do the work.

Closed bodies now afford much better vision for the driver because of improved design which includes smaller supports at either end of the windshield. Automatic windshield wipers provide clear vision in rain storms and give reasonably good results in snow storms, but there is till need for cleaning devices that will wipe over a larger area of the windshield. Sunshades afford good protection when driving into the early morning and late afternoon sun. Such other devices as mirrors, rear signals, driving lights, bumpers, etc., complete a story of commendable work on the part of engineers and manufacturers to conserve the energies of the operators and thereby contribute ably to the safer use of our streets.

LIGHTS

The lights carried on vehicles should be given careful thought, because at present there is such an abuse of different colored lights to be seen on approaching vehicles as to create confusion, not only in the minds of pedestrians, but with other vehicles traveling in the opposite direction. Simplicity in the scheme of lights is the first and great consideration. Only one color of light should be visible from the front of the vehicle, and that the white light.

The use of red lights, to be seen from the front of the vehicle, should not only be discouraged but prohibited. The use of the green light to the front should be equally prohibited. Green light throughout our traffic system is sup-

posed to mean a clear course, an open thoroughfare, and no other use of the light should be permitted. On motor buses, motor trucks and taxicabs, where lights are used to designate routes or public service vehicles, the white light should be used. If it is necessary to indicate the extreme left side of the body of a motor bus, or a motor truck, some combination of white light can be effectively used and should be used.

The lights carried on the rear of a vehicle should be as simple as possible and made to conform with the general code of colors. The red tail light can, if desired, be placed at the extreme left rear to indicate body width and also to give some indication as to whether the vehicle is a motor bus or truck. Under no circumstances should the green light, to indicate body width or as part of a stop signal, be permitted. For the stop signal there is the possibility of using an additional red light, which is very effective, and also the yellow light, which is generally accepted as a caution signal.

Small parking lights on the fenders are not only desirable but highly commendable, in that they indicate the maximum extreme of the vehicle, and no vehicles should be permitted to park after sunset, even on moonlight nights, without some light showing in both directions.

BRAKES

In framing regulations relating to motor vehicle equipment the subject of attention to brakes should not be overlooked. While accident reports generally show few accidents due to faulty brakes, it is nevertheless a fact that too frequently brakes are not given the attention they should have. In the past five years more attention and quite considerable progress has been made toward better brakes, but much more remains to be done. The fact that the holding factor of many brakes is reduced for a time when wet, is a matter that makes the brake question all the more important.

The careful, thoughtful driver almost invariably tests the brakes as soon as the vehicle is out of the garage. This is insisted upon by many of the best operators of fleets of motor trucks, motor buses, and taxicabs, and should be insisted upon, if possible, with every operator of a motor vehicle. Not only would it be a warning of the condition of the brakes, but it would keep the brakes in the consciousness of the operator much the same as the supply of gasoline is in his consciousness today. If possible there should be at least one time in the year when brakes are officially passed upon, if for no other reason than for the fact that it would be a factor in focussing the attention of every motorist on this most important subject.

It is possible that street-side service stations that now give service by way of chassis lubrication will take up the question of brake attention. Today the service station attendant, after supplying the necessary gasoline, asks about oil, water, and sometimes chassis lubrication or spring lubrication, but never asks about the brakes.

The use of the muffler cut-out on the streets should not only be discouraged but prohibited because of the unnecessary noise. The cut-out is very desirable in the garage for testing purposes, and its being fitted to the vehicle is desirable in many ways, but the abuse of it on the streets, and frequently as a signal, should not be tolerated.

CONCLUSION

The time is not far distant when automatic windshield wipers will be required by law in practically all parts of the country just as mirrors, horns and headlights are required today. The rear signal is not only an essential but a

great safety factor, and while all of the new vehicles are equipped with such, or nearly so, there are many vehicles on the streets not so equipped.

The equipment of a motor vehicle has progressed almost steadily during the past five years, and each year will register some little advance in this field. The vehicle manufacturer so keenly recognizes the merchandising value of such equipment that he is sure to keep advancing from season to season.

Anti-theft locks of very many different kinds are in use, but it is almost impossible to fit any lock that does not admit of being tampered with and the vehicle stolen. Some ridiculous regulations have been attempted in different cities by way of approving signal devices of one kind or another that would attract the police in case a vehicle is being stolen. Generally these have been so unsatisfactory that they have been short-lived.

Some very definite improvements have been made by way of anti-theft number plates for the engine or dash of the car. It is possible that some number plate, with particular merit, may come in for general adoption, but it should be kept in mind that more factors than car locks or license plates enter into the matter of vehicle theft. Very frequently laws governing registrations and vehicle transfers are important factors.

The Problem of the Standing Vehicle

By Harold S. Buttenheim
Editor, *The American City*

AT his own store door, Merchant A benefits only by *to* traffic. Everywhere else in his trade territory, facilities for *through* traffic in his direction have a direct bearing on his prosperity. But in this same region are located Merchants B to Z, each of whom is interested in attracting a maximum of traffic to *his* store door, but feels little concern for facilitating traffic to the door of Merchant A. The conflict of these warring interests lies at the root of the problem of the standing vehicle.

As in many another problem of modern city life, a solution would be reached more speedily if we could eliminate selfishness from human nature, and replace conflict with coöperation. But, as is also true of these other problems, a kindly willingness to see things through the other fellow's eyes will not suffice; there must be the scientific approach which will substitute real insight into the problem for a mere point of view about it.

It was for these reasons that *The American City* undertook some months ago, with the coöperation of a group of city planners and traffic consultants, to draft a set of principles which might aid municipal officials and business men in formulating local policies as to the parking and storage of automobiles, and the facilitation of street traffic and transportation. In suggesting this study these two questions were propounded:

(a) Must our expanding cities look forward to constantly growing expenditures of staggering amounts for street widenings, sidewalk arcades, elevated and underground traffic ways, and other devices for permitting more and more automobiles to move—and park—in downtown business streets?

(b) On the other hand, can our progressive business men no longer build big retail shops, theatres and other structures where the crowds congregate, with reasonable expectation that the city will somehow make it possible for their customers to continue to arrive—and park—by automobile?

A statement of principles built up by *The American City*, with the advice—and, in most cases, the consent—of the collaborators[1] is here embodied in the paragraphs set in italic type; the rest of the present article comprises comments or additional data from various sources which may serve either to fortify the recommendations made or to present other points of view.

The Primary Purpose of Streets

1. *Streets are primarily provided for general public use as lines of communication for pedestrians and for the transportation of persons and merchandise; and the rights of the different classes of traffic to unlimited use of the streets, including the right to park, are subject to the public and civic welfare.*

[1] Those who coöperated in formulating this body of doctrine were George B. Ford, E. P. Goodrich, Robert Whitten, Lawson Purdy, and the Beeler Organization, New York; Harland Bartholomew, St. Louis; Miller McClintock, the Erskine Bureau for Street Traffic Research, Harvard University; J. Rowland Bibbins, Washington, D. C.; Walter Jackson, Mt. Vernon, N. Y.; Delos F. Wilcox, Grand Rapids, Mich.; Sidney J. Williams, Chicago, and the Domestic Commerce Division, Department of Commerce, Washington, D. C.

In American and English law the right of the state to keep its highways free for traffic has as one of its most notable precedents a judicial utterance made in 1812 by the great jurist, Ellenborough, Lord Chief Justice of England. It was in the case of *Rex* v. *Cross*, in which the defendant was indicted for allowing his coaches to remain an unreasonable time in the public street. The Court said: "Every unauthorized obstruction of a highway to the annoyance of the king's subjects is a nuisance. The king's highway is not to be used as a stable yard." This authority has been repeatedly quoted with approval in American courts, including the New York case of *Cohen* v. *Mayor*, 113 N. Y. 532–535, in which Judge Peckham said:

> The primary use of the highway is for the purpose of permitting the passing and repassing of the public, and it is entitled to unobstructed and unoccupied use of the entire width of the highway for that purpose, under temporary exceptions for deposits for building purposes and to load and unload wagons, and to receive and take away property for or in the interest of the owner of the adjoining premises, which it is not now necessary to more specifically enumerate.

One reason for the present chaotic condition of traffic laws and ordinances is the fact that the problem, as accentuated by the automobile, is a very new one. As recently as 1916 Henry C. Wright, then a member of the Mitchel administration in New York, was able to write, in a treatise on city government, that "cities of less than 200,000 population seldom have traffic congestion that requires regulation." Verily we advance—as rapidly as the congestion generated by our "progress" will permit.

UNLIMITED PARKING—WHEN AND WHERE

2. *Unlimited parking may properly be allowed at all times in all business districts where it does not cost the traveling public more than it saves those who park, nor interfere with the expeditious movement and safety of street traffic, and with reasonable access of vehicles to the curb.*

Strictly interpreted, this will mean an end to unlimited parking on all important shopping streets, as well as in front of hotels and theatres; for the saving in time or convenience to the few who can find space to park on busy thoroughfares is greatly outbalanced by the dangers and disadvantages to others. For example:

(a) Unrestricted parking prevents the cars of prospective shoppers from having free access to the curb, and also handicaps seriously the unloading of trucks and delivery wagons.

(b) Parking adds greatly to the danger of accidents to pedestrians, who are prone to dart out from the side of a parked vehicle in front of an oncoming car.

(c) Parked cars are a hindrance to the rapid and safe passage of fire-fighting apparatus through the streets, and are an exceedingly serious menace when they have been left locked in front of property on which a fire breaks out.

(d) Parking space theoretically provided for customers is too often monopolized by the cars of the owners or employes of the store itself, or of other nearby merchants.

Warning against two particularly objectionable methods of parking is voiced in a letter to *The American City* from Sidney J. Williams, director of the Public Safety Division of the National Safety Council:

> I feel that special attention should be directed to the evils of double parking and parking opposite a loading zone on a street of ordinary width where such practice either interferes with the movement of traffic, or leads drivers to drive through the loading zone. Under "parking" I mean here to include even the most temporary

stopping of a vehicle to load or unload passengers or goods. Not only should double parking, and parking opposite or near a loading zone, be strictly prohibited, but any tendency to such parking should be taken to indicate that the parking restrictions in that block should be made more strict, so that there will always be room at the curb to stop for the loading and unloading of passengers or material.

Too little thought is ordinarily given to the value of the space occupied on a street by a parked car. It would doubtless be fair to figure the surface of a street as worth fully as much per square foot as the front of the abutting property. As a mere matter of economics, ought the municipality to allow its citizens to use this valuable space without compensation if such use is to the detriment of other citizens?

AIDS TO TRAFFIC SAFETY AND FACILITATION

3. *As vehicular traffic density increases, every reasonable effort should be made to expedite movement and make it more safe, by the use of pavement markings, traffic signs and signals, the designation of one-way and "through" streets, the employment of adequately trained traffic officers, and other aids to traffic safety and facilitation; and traffic ordinances and parking regulations should give recognition to the manifold interests represented by public transportation vehicles.*

As the various methods of expediting traffic enumerated in the foregoing paragraph are covered by other writers in this issue of the ANNALS, I shall not attempt to discuss this phase of the subject, except to offer one observation. Many estimates have been made in local traffic surveys as to the economic cost of congestion on the highways, and there has often been the naïve inference that, by such palliatives as are suggested in the foregoing paragraph, traffic will be speeded up to such an extent that the inconvenience and expense of traffic delays will largely disappear. But the fact seems too often to be overlooked or ignored that these very devices act as a magnet to draw more automobiles to streets where traffic has thus been made, for the time being, more safe and speedy. The real result, therefore, after a short interval of readjustment, will ordinarily be a larger volume of traffic on the streets rather than any great increase in average speed of travel. In other words, traffic signs, signals and pavement markings are to be recommended as aids to handling more cars per hour, or the same number of cars with greater safety, but not in the long run as decreasing the need for keeping the streets as free as possible from standing vehicles.

In comment on the clause in paragraph 3 which urges proper recognition of the interests represented by public transportation vehicles, Walter Jackson, fare and bus consultant, writes:

To appreciate the extent to which the parked automobile has become a parasite on the streets, consider the howl of execration that goes up if a trolley car is parked on a siding! One of my clients spent many thousands of dollars to comply with public clamor against a maximum layover of three minutes on the very same block where two score automobiles were and still are parked all day long.

The personal machine uses up so much of the street area in proportion to its passengers that those who simply must enjoy such exclusiveness ought to pay for it in the form of garage fees. Merchants who encourage parking are surely shortsighted. Not more than two or three autos bringing hardly six customers will block off the view of their show windows from pedestrians on the opposite side and from persons riding by. On the other hand, one trolley car or bus will deposit twenty customers at their doors every few minutes and not linger a second longer than the interchange of passengers requires. Only the public utility transport

vehicle leaves the merchant's curbs free for loading and unloading his goods.

Mr. Jackson might also have called attention to the howl of execration which would go up if street cars were run by gasoline and were allowed to fill their tanks on the public highway. But many cities continue to tolerate the filling station on the edge of the street for the service of private automobiles. Here, at least, public sentiment is demanding the curbing of the curb pump with an insistence which is resulting in the increasing use of the "drive-in" type of service station.

LIMITATION OR ABOLITION OF PARKING

4. *The right to move a car is superior to the right to store a car on the public ways, and when or where parking causes a net economic loss to the public through hindrance to safe and convenient travel, there should be limitation—or in extreme cases, at certain hours, total abolition—of parking, both commercial and private. In some cities the complete prohibition during certain hours of private motor and horse-drawn vehicles from congested downtown districts, and limitation of commercial vehicles to consolidated service, is to be regarded as an ultimate possibility.*

The "squatters" who monopolize curb space in the downtown business district during the entire business day have brought forcibly to the fore, as someone has suggested, the problem—not unknown in this country—of contending with "squatters' rights." Fortunately, such rights on the highways have not become "vested," and the municipality can enforce any reasonable regulations to prevent the obstruction of public thoroughfares.

Perhaps the most simple and practicable first step is an ordinance prohibiting all downtown parking between 8 and 9:30 in the morning and 4:30 to 6 in the evening—or during whatever hours, in any city, the bulk of the employes in the business district go to and from their work. This has the double advantage of keeping the business streets free from parked cars during the period when they are carrying their peak loads, and also of preventing the merchants and their employes from parking their own cars in space which ought to be available for the cars of their customers. During the rest of the day a time limit for parking may be set—though, as Miller McClintock points out in his discussion of "Recent Developments in Street Traffic Relief and Control," in *The Municipal Index* for 1927, so far as is known, no police department has as yet been able to devise a method which makes possible continued enforcement of parking regulations without the use of a larger personnel than is justifiable; and, at best, time limits do not materially affect the traffic capacity of the roadway.

In a progress report submitted at the 1927 convention of the National Highway Traffic Association, as chairman of its Committee on Parking Regulations, Roger L. Morrison, associate professor of Highway Engineering of the University of Michigan, suggested that in fixing the length of time a car may be parked, it is unwise to make the limit so short as to encourage the moving of vehicles from one parking place to another in the immediate vicinity. Mr. Morrison also advocated the reservation of spaces in congested districts, probably at the end of each block, for very short time parking to facilitate the delivery of packages and the performing of other short errands which commonly cause double parking. This is in line with the so-called loading zone regulation, in use in Los Angeles for several years past, which eliminates the necessity for double-line parking but does not, of course, give to moving traffic any part of the street surface

which is at present used for parking. The recently proposed Chicago code provides that:

During the times specified herein it shall be unlawful for an operator to stand a passenger vehicle for a period of time longer than is necessary for the loading and unloading of passengers, providing such loading or unloading shall not consume more than three minutes; nor for an operator to stand any commercial vehicle for a period of time longer than is necessary to load, unload and deliver materials, provided that the loading, unloading and delivery of materials shall not consume more than thirty minutes . . . in any loading zone.

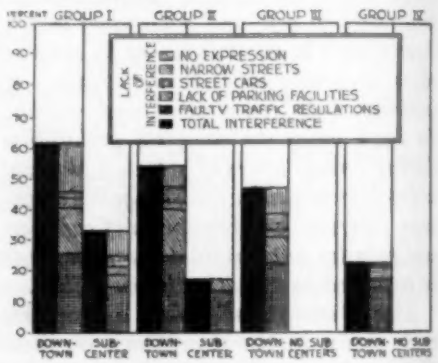
The growing popularity of motor buses for suburban and interurban travel has added another difficult question to the long list of parking problems. In New York City an order has been issued by Police Commissioner Warren, requiring all passenger motor carriers entering the city to provide off-street private terminals prior to the opening of The Holland Vehicular Tunnel in October. This order was sent to eighty-four motor carriers operating a total of some five hundred buses. Sight-seeing buses, however, were not included in the order.

As a safety measure, the prohibition of parking on the main traveled portions of rural highways demands legal sanction, which it is gradually receiving. Minnesota's new traffic code, for example, adopted by the 1927 Legislature, provides that no person shall leave any vehicle standing, whether attended or not, upon the paved or improved or main traveled portion of any highway, outside a municipality, when it is practicable to park it off the paved or main traveled portion of the road. Then it adds:

In no event shall any person leave standing any vehicle upon any highway unless a clear and unobstructed width of not less than fifteen feet upon the main traveled portion of said highway opposite such standing vehicle shall be left free for passage of other vehicles thereon, nor unless a clear view of such vehicle may be obtained from a distance of 200 feet in each direction upon such highway.

THE ATTITUDE OF RETAIL MERCHANTS

The most active and determined opposition to restricted parking is apt to come from the merchants who in the long run would be most benefited by it. Many retailers have an exaggerated idea of the business they would lose—and underestimate greatly the business they would gain—if unrestricted parking were abolished. Much has been done to clarify this problem by the Domestic Commerce Division of the United States Department of Commerce, in the publication last year of a 52-page



PERCENTAGE OF STORES INDICATING INTERFERENCE WITH BUSINESS BY VEHICULAR TRAFFIC CONGESTION, AND THE CHIEF FACTORS CAUSING THAT CONGESTION, AS REPORTED BY 1426 MERCHANTS

It is interesting to note from this that most stores reported the chief cause of vehicular-traffic congestion to be faulty traffic regulations. Various forms of traffic regulation have perhaps aided the problem more than anything else, but there is still much to be done. Problems incident to traffic regulations, as a cause, are said to be the result of the following: unenforced regulations, unnecessary regulations, misfitted regulations, and insufficient regulations

(For population figures of the four groups of cities, see Table I)

pamphlet on *Vehicular Traffic Congestion and Retail Business*. This study, which was based on expressions of opinion by 1426 merchants in 841 cities and towns, showed a growing recognition of the need for some restriction on parking and a general belief that the length of parking time should coincide with the length of a shopping period. The question then becomes, "What is the length of a reasonable shopping period?" On this subject 1057 stores reported their experience. Classifying all periods under the following five general periods, of less than one-half hour, one-half to one hour, one hour, one to two hours, and two hours or more, it is found that the average shopping periods in all reporting stores in the four groups of cities is as shown in the following table:

TABLE I—AVERAGE SHOPPING TIME IN CITIES IN THE FOUR GROUPS
(Per Cent of Stores)

Group	Stores Reporting	Less Than ½ Hour %	½ to 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %
Group I	195	52	29	11	4	4
Group II	135	53	37	9	0	1
Group III	265	69	27	3	.5	.5
Group IV	462	82	16	1.5	0	.5

AVERAGE SHOPPING TIME IN CITIES IN GROUP I
(Based on 195 Replies from Cities Over 200,000 in Population)

Kind of Store	Stores Reporting	Less Than ½ Hour %	½ to 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %
Dry goods	47	11	36	23	15	15
Hardware	8	75	25	0	0	0
Clothing	36	75	14	11	0	0
Grocery	9	89	11	0	0	0
Shoe	26	46	50	4	0	0
Drug	19	95	5	0	0	0
Jewelry	28	75	25	0	0	0
Furniture	22	23	50	23	4	0

AVERAGE SHOPPING TIME IN CITIES IN GROUP II
(Based on 135 Replies from Cities 50,000 to 200,000 in Population)

Kind of Store	Stores Reporting	Less Than ½ Hour %	½ to 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %
Dry goods	57	37	42	19	0	2
Hardware	21	100	0	0	0	0
Clothing	10	50	50	0	0	0
Shoe	47	53	45	2	0	0

TABLE I—AVERAGE SHOPPING TIME IN CITIES IN THE FOUR GROUPS—*Continued*

AVERAGE SHOPPING TIME IN CITIES IN GROUP III

(Based on 265 Replies from Cities 10,000 to 50,000 in Population)

Kind of Store	Stores Reporting	Less Than ½ Hour %	½ to 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %
Dry goods	86	42	50	6	1	1
Hardware	89	98	1	1	0	0
Clothing	9	67	33	0	0	0
Shoe	81	67	30	2	1	0

AVERAGE SHOPPING TIME IN CITIES IN GROUP IV

(Based on 462 Replies from Incorporated Places 2,500 to 10,000 in Population)

Kind of Store	Stores Reporting	Less Than ½ Hour %	½ to 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %
Dry goods	73	60	32	7	0	1
Hardware	307	90	9	.5	0	.5
Clothing	8	75	25	0	0	0
Shoe	74	72	27	1	0	0

In commenting on the foregoing table the Domestic Commerce Division says:

It will be noted that the majority of all recorded stores reported the average shopping period to be less than one-half hour and that this is true to a greater extent as cities decrease in size. The longer shopping periods of one hour or more are found to occur in the largest cities and are almost negligible in cities of less than 50,000 in population. It is evident that the shopping period is longest where there is more traffic congestion and at the same time less opportunity for a long parking time privilege.

The merchants were asked also to express their preference for length of time of limited parking, or to state whether they favored unlimited parking or no parking. To these inquiries 1154 replies were received, as follows:

TABLE II—PARKING REGULATIONS FAVORED BY MERCHANTS IN THE FOUR GROUPS OF CITIES

Group	Stores Reporting	Limited Parking					Unlimited Parking	No Parking
		Total %	Less Than 1 Hour %	1 Hour %	1 to 2 Hours %	2 Hours or More %	%	%
Group I	219	95	33	55	6	6	4	1
Group II	159	96	46	46	2	6	1	3
Group III	287	82	36	45	8	11	18	0
Group IV	489	35	39	37	3	21	65	0

The number of customers shopping by automobiles is apt to be overestimated by the merchants, especially in the larger cities. In Miller McClintock's recent Chicago study, the results of which are embodied in the 300-page *Report of the Metropolitan Street Traffic Survey of Chicago* (published by the Chicago Association of Commerce), elaborate investigations were made to find if curb parking supplied a substantial part of the patronage of retail stores, or if this had a negligible connection with retail business. Merchants assisted in this survey by interviewing their customers. Of 96,000 store patrons interviewed in the Loop stores, only about 8 per cent come to the district in automobiles and but 1.57 per cent park their cars at the curb. The remainder of the automobile patrons come in chauffeur-driven cars, or store them in off-street spaces.

THREE CONSTRUCTIVE METHODS OF RELIEF

5. *If the active and impartial enforcement of regulations such as those suggested in paragraph 4—and the alternative of intolerable congestion in the streets—are considered by business men to be to the disadvantage of business in certain districts, an attempt should be made to solve the problem by one or more of three methods:*

(a) *By the provision or improvement of by-pass routes for through traffic, if congestion on the downtown streets is due in a considerable degree to traffic which has no need to be in the district under consideration; such by-pass routes to be designed, wherever economically justifiable, with separated grades to permit uninterrupted flow of traffic;*

(b) *By the provision of storage garages or other off-the-street parking and loading facilities on private property, by the business interests affected, at their own expense, and with a low rate of charge to their customers;*

(c) *By the widening, arcading, or double-decking of existing downtown streets—only to such an extent, however, as property owners on these streets are willing to pay, by benefit assessments (payable over a period of years) for so much of the land and construction costs as may be for their benefit; the principle being recognized that if the city as a whole were required to pay the cost of congested-district street widening, arcading or double-decking, the building of by-pass routes would ordinarily be a much wiser expenditure of municipal funds.*

In these three proposals we begin to attack some of the basic relationships of the parking problem to the much bigger and broader problem of city planning and zoning. Even more fundamental would be an attack on the evils of street congestion by much more drastic limitations of building heights and of density of population than our larger cities have as yet adopted. The opinion is gaining ground among city planners that cities not having subways or elevated railroads—and what city wants either?—would be wise to limit buildings to a maximum height equivalent to the width of the street on which they face. Exceptions might be made where the setback-volume principle is adopted, under which regulation is by bulk, figured in cubical contents, rather than by height.

A simple and rational application of this cubical contents principle to most business districts of cities would be to allow no building to be erected to a height greater than the width of its street, unless by provisions of yards, courts, or setbacks the cubical contents of the building are kept down to a bulk not exceeding the area of the lot multiplied by the width of the street; inner courts not opening on streets, alleys, or yards to be considered as parts of the

cubical contents of the building. For cities of less than 20,000 population even this proposal—which may seem drastic to the larger cities—will permit a needlessly intensive use of the land, and a flat limitation of from three to six stories for business and office buildings may prove acceptable for many years to come. It should be added that it is not merely the comparatively small number of skyscrapers which cause an acute traffic problem, but the too intensive use of land for apartment houses. It is to be hoped that most American cities will soon follow the lead of the few which are now regulating effectively, under zoning ordinances or building codes, the number of families which may be housed per acre.

In some cities the municipality itself has attempted to relieve street congestion by providing parking space on public property, or garage space in public buildings. Sometimes there is available for this purpose a building site which the city is not yet ready to use, or waterfront space not needed for other purposes. As a rule, however, sound public policy would seem to require that off-the-street automobile storage be left to private enterprise, or that when undertaken by the municipality fees be charged sufficient to cover an adequate return on the value of the land plus the cost of supervision.

An interesting example is the Union Market and Garage Building recently erected by the city of St. Louis, at a cost of $1,275,000, on land valued at about $750,000. The lower floors of this building are occupied by a public market and the three upper floors are operated twelve hours a day as a public garage for the storage of automobiles. Special mention should also be made of the new State Office Building now under construction in Albany, N. Y., in which State Architect Sullivan W. Jones has made provision for parking official cars in the basement of the structure with ramps leading to the parking spaces from the rear of the building.

ALTERNATIVES FOR THE FUTURE

6. *All future department stores, theatres, tall office buildings, and other business structures catering to large numbers of customers or tenants should be built, therefore, only with a knowledge by the owner that he must either provide space himself for loading and unloading of merchandise and for storage of his customers', tenants', and employes' cars; or depend on the trade and services of persons who travel by foot or public conveyance; or establish branch shops, banks, neighborhood theatres, etc., outside of the congested centers, in areas properly zoned and so planned that there will be free circulation with ample parking space and a segregation of trucking and delivery by means of alleys or otherwise.*

The providing of off-street facilities for storage of the automobiles of customers or tenants and for loading and unloading of merchandise has already become a reality in a growing list of cities. In Chicago, San Francisco, Washington, Toledo, and other cities, office buildings have recently been erected in which storage space is provided for the cars of tenants. Hotels and department stores in increasing numbers are providing garage space, in their own or nearby buildings, for their guests and shoppers.

On this subject the above-mentioned report of the Department of Commerce says:

> Efforts on the part of the merchants to adjust store service to meet the need for parking space have taken the form of garage service, outdoor parking-area service, bus service, and chauffeur service. Eighty of these services have been reported in the present survey. A few are principally means of relieving the customer's mind from anxiety in respect to parking regulations;

others are part of an advertising program. Most of them, however, do considerable to relieve traffic congestion. This survey indicates that parking services offered by merchants remove from the streets more than a million cars annually.

PROVIDING OFF-STREET FACILITIES BY VOLUNTARY AGREEMENT OR BY LAW

Writing in *System* for May, 1927, on "Controlling Traffic to Speed Up Business" Miller McClintock expresses the opinion that:

> No retailer should construct a building to house his business without complete provision for receipt and loading of merchandise entirely within the structure. He must stop competing with his prospective customers on the streets. Incidental benefits accruing from interior loading in the way of greater safety for goods, better protection from the elements, and more efficient handling of merchandise will assist in carrying the outlay involved.

Discussing the importance of more adequate intown terminal facilities, in the same article, Dr. McClintock says:

> In the larger cities of the country, there are today more than 100 parking services offered by merchants or by groups of merchants. These facilities range from small outdoor parking lots, where merchants have an agreement with operators for the care of customer's cars, to large-capacity modern garages, owned and operated by merchants.
>
> Boston shows an unusual variety and progress in customer parking service. Through the Retail Trade Board about 100 stores have developed a coöperative garaging plan.[2] The Board has entered into an agreement with commercial garage owners whereby, during the morning hours, customers may park without charge, and in the afternoon at a reduced rate.
>
> Another retail group and many individual merchants have entered into agreements for customer space in the recently completed Motor Mart Garage. While the agreements vary somewhat, the principle is that if the claim check is stamped by the merchant, the owner may reclaim his car without cost. The garage, in turn, bills the merchant.

These movements in various cities are being stimulated, no doubt, not only by a desire to attract trade to existing downtown streets, but as a means of overcoming in some degree the trend towards the development of neighborhood shopping and amusement centers in outlying sections.

In Pittsburgh, as this article is being written, there is under consideration a proposal to require by law that parking and loading space be included in or adjacent to new large buildings in the main business districts of the city. On this subject Burton W. Marsh, traffic engineer of the city of Pittsburgh, writes:

> Of course, builders are gradually forced to the realization that they must make such provisions, but it seems to me that there is too much *lag* in the coming of this realization. Therefore, perhaps, mainly with the idea of attracting wide attention and discussion on the subject, but yet with the feeling that there is some reason for the idea, we are considering the possibility of an ordinance providing that after a specified date, all buildings over a certain minimum cubage shall make provision for loading and parking within their property lines. Of course, the problem arises as to what the minimum cubage for the building should be and as to how extensive provisions should be made. It may well be, for instance, that it would be reasonable to require a hotel to provide a considerably different amount of space for such purposes than an office building or a public utilities building.

This Pittsburgh proposal has been anticipated in at least one other city, West Palm Beach, Fla., where in a zoning ordinance passed October 31,1926, it is required that under certain conditions commercial establishments must provide on their own land for parking in

[2] "Details of the Board's plan were given in "Where Can the Shopper Park His Car?" in *System*, for May, 1926.

connection with their own business. These provisions apply to some buildings already erected and there are much stricter requirements for new subdivision plans.

In Los Angeles the Eberle & Riggleman Economic Service issued on November 22, 1926, a bulletin reporting the increases in downtown business corner lot values for the period from 1907 to 1926 inclusive. This bulletin shows an average increase of nearly 400 per cent in values in the twenty years, but points out the fact that while there have been large and rapid gains in the values of certain lots in the downtown business section of Los Angeles during these two decades, it is not so generally known that some of the values are less than they were twenty years ago. In contrast with this condition a study by the same statisticians, published May 30, 1927, showed increases in values in eight *neighborhood* business districts of Los Angeles in the last *ten* years of from 433 to 1450 per cent, the average for the eight districts being over 800 per cent. It is to be hoped that in Los Angeles, and in the hundreds of other cities where downtown congestion is hastening the development of neighborhood centers, property owners and merchants will profit by the mistakes made in the sections already built up, and encourage the reservation of ample space, by public and private initiative, for street widening and for automobile parking and storage, while cheap land is still obtainable.

Robert Whitten, city planning consultant, one of the collaborators in the statement of principles on which this chapter is based, expresses the opinion that there is an over-emphasis of the relation of the downtown business interests to the parking problem. Says Mr. Whitten:

> The main consideration should be that of maximum service and convenience to all those who use the streets for a legitimate transportation purpose. This same mistake of emphasis is often made in discussing street-car service. The routing of cars is discussed with reference to advantage or disadvantage to the large stores rather than with reference to the convenience of the car rider.
>
> It is to the interest of the public that adequate facilities be provided for each type of street transportation (private automobile, taxicab, street car, or bus) so that each agency will be able to supply that kind of service that it is best adapted to furnish. The private automobile is in most cities performing a highly important function. It is transporting people on numerous business and social trips with an advantage in time and convenience that cannot be approached, within its special field, by any other agency. Reasonable opportunity for short-time stops is, of course, essential to the use of the private automobile in this way. Such use in most cities is so general that it becomes a matter of public convenience and necessity, not merely that of its effect on the business interests.
>
> Reasonable parking privileges are of direct advantage to automobile owners generally and *they* should be called upon in largest measure to defray the cost of all improved traffic facilities, including the provision of reasonable facilities for short-time stops. Through registration fees and gasoline taxes the automobile users are building the state highways. They will have to stand still heavier burdens in order to cope with increasing congestion in the cities. It is decidedly to their interest to do this, as otherwise the large investment that they now have in private cars will become useless. The problem for most cities is not insuperable. The construction of by-pass express roads and the creation of necessary parking facilities can be justified by the direct economic advantage to the users of these facilities.

A DELIBERATE POLICY OF DECENTRALIZATION ADVOCATED

7. *The foregoing statement of principles is based on the growing body of opinion, among city planners and municipal*

administrators, that congestion in the business centers of our great cities is a malady which cannot be cured by providing facilities for greater congestion; that, in the public interest, every city must consider a deliberate policy for decentralization and the adoption of a plan for major street and transit developments with a fair division of cost between the city and the benefited property; and that thereafter projects primarily of local interest must be locally financed.

Not only will a decentralized city afford greater comfort and safety to most of its inhabitants, but the majority of real estate owners will profit by a spreading-out of values, as against the piling-up of excessive values for the benefit of a few in a highly congested center. Other business groups will profit also by making it possible for the maximum number of cars to travel in comfort on the streets. Automobile manufacturers, dealers, and service stations, for example, have a very definite financial interest in the parking problem and in the prevention of too intensive use of the land by skyscrapers and apartment houses. There will obviously be a much larger market for automobiles if there is not too great congestion in the streets of our cities.

The advocacy in paragraph 7 of a deliberate policy of decentralization is considered by A. Heath Onthank, chief of the Domestic Commerce Division of the U. S. Department of Commerce, as being of such breadth that he cannot subscribe to it. On this subject Mr. Onthank writes to *The American City:*

> In the study made by this Division and published as *Vehicular Traffic Congestion and Retail Business*, it was found that only the large cities are decentralizing and that the smaller and many of the medium-sized cities are still centralizing and will continue to do so for many years to come. In the latter cases, such a movement was for the most part distinctly to the advantage of these municipalities. It is doubtful if many of them will grow to the point where they should ever adopt a scheme of decentralization. That being the case, I do not believe it is wise to force them to consider such action at probably considerable expense.

The chief question here seems to be as to how large a city must become before a policy of decentralization is to be recommended. The answer, doubtless, is in the lap of the gods—or in the brains of our scientists and the enterprise of our captains of industry. Not the least important of these imponderable factors may be the development of commercial aviation. Adequate space for airports will, as a rule, be found only in the fringes of our cities, and the traffic which these landing fields will ultimately attract—by air and sea and land—may hasten greatly the process of urban decentralization. And perhaps not many years will elapse before the editor of THE ANNALS will be asking some city planner to write a chapter on "The Problem of the Standing Airplane." Who knows?

Finding the Causes of Accidents

By Sidney J. Williams

Director, Public Safety Division, National Safety Council

WHAT is the cause of an automobile accident? From the standpoint of the pedestrian the immediate and obvious cause is the automobile. Going a little farther back, the cause is often stated as "carelessness" or "inattention" on the part of the driver or perhaps on the part of the pedestrian. Along with this there is frequently a violation of some written or unwritten rule of the road: excessive speed, driving on the wrong side of the street, making a turn in a faulty manner, failing to yield the right of way; or, on the part of the pedestrian, crossing against the traffic signal or in the middle of the block. Sometimes, though not very often, poor visibility (itself arising from any one of several factors) is a contributing cause; likewise slippery pavements, snow or fog, defective brakes, or some other mechanical failure. There are usually more than one, sometimes half a dozen such "causes" for one accident. And back of these there are still other considerations that enter in: the design and the condition of the roadway and of the street system in general; the methods of controlling traffic; the laws and the enforcement of them; and a host of personal characteristics—eyesight, hearing, reaction time, and all the permanent or temporary conditions of mind or body which lead to "inattention" and "carelessness."

The cause of an accident is thus quite a complicated affair, which explains why the preventing of it is often so difficult.

The problem, however, is perhaps not quite so complex when we look at it in this light: nearly every accident (other than the rare cases of mechanical failure) occurs because some one or more persons, usually the driver, did not try hard enough to drive safely under the existing conditions. He took a chance. He had taken a similar chance often before, and had gotten away with it, but this time he did not get away with it. It is not contended that automobiling can or should be entirely divorced from chance taking, but it is certainly true that if every driver and every pedestrian would refrain from taking those chances which are obviously fraught with danger, the accident rate would immediately take a big tumble.

From this point of view, good streets, good control systems, good cars and brakes, simply make safe driving easier. Good highways, well-lighted and well-controlled, are desirable because they make driving more convenient and more comfortable, but they do not prevent accidents if the element of personal caution is lacking. Many people can and do drive safely under the most adverse conditions, and many others can and do drive unsafely under the most favorable conditions.

The most of us, of course, come somewhere in between. It is true that for these drivers who exercise a moderate degree of caution, the safety of the highway is increased by engineering improvements, proper control, and by a well-constructed and well-equipped vehicle. And it is true that we need to study, much more thoroughly than has

ever been done, the real causes underlying the occurrence of automobile accidents.

SAFETY CAMPAIGNS BASED ON FACTS, NOT GUESSES

A few examples will show how profoundly a knowledge of the facts of accidents must underlie any attempt to prevent those accidents.

In a certain large city where over a hundred children are killed annually in traffic, a study of the records disclosed that nearly half of the fatal and serious accidents occurred in the block where the child was living and more than two-thirds were no further away than the next block; also that by far the greatest number occurred between 4 and 8 P. M. These figures proved beyond question that the problem of traffic accidents to children in that city was a problem of the child playing in the immediate vicinity of his home, especially during the evening rush hour, and not a problem of transporting the child to and from school.

In comparing automobile accidents in various cities over a certain period it was found that in some cities more than 80 per cent of the persons killed were pedestrians, while in other cities only 20 or 30 per cent were pedestrians. Of these pedestrian victims, in one city 61 per cent were children under 15, while in another city only 22 per cent were children.

Of all fatal accidents to children under five, more than half occur in the home and one-quarter on the street. Of such accidents to children from five to fourteen, more than half occur on the street and only one-fifth in the home.

Accident spot maps of cities usually show that serious traffic accidents are rare in the central business district, but frequent on the thoroughfares radiating from the business district and passing through congested residential sections.

Any public official or organizer desiring to reduce accidents in his community, and having before him such facts as those just mentioned, would undoubtedly use them as the basis of his program. They would largely influence his decision as to what street improvements to recommend, what legislation to promote, and what educational activities to carry on. They would provide him in advance with ammunition to answer any charges that his proposals were impracticable or unnecessary.

It is just as certain that any engineering, legislative, or educational remedies for accidents, not based on a knowledge of the facts, run a big risk of being unsound and of not producing the desired results.

Yet despite these facts, which are so obvious as hardly to require statement, we have been and still are woefully ignorant of the facts of street accidents. Much safety effort has been based on "common knowledge" at the best, guesswork at the worst. Most safety workers have recognized this problem and have done their best to utilize such facts as were available, but all have recognized that with more complete information their work could be made more effective. For example, we do not know with any real definiteness just what results have been produced by the licensing and examination of drivers. Impartial engineers and statisticians, examining such data as are available, have come to the conclusion that in general these laws do have a beneficial effect—but the opponents of such legislation are still able to claim that the statistical evidence is meager.

THE SOURCES OF ACCIDENT INFORMATION

The principal sources of information on the facts about accidents are:

1. Our well-developed system of death registration starting with local health officers and culminating in the United States Bureau of the Census. The reports of the Census Bureau, and of even the best state and city health departments, are limited to fatal cases. This is a serious limitation, for several reasons, one of which is that the percentage distribution of the non-fatal cases, as to type of accident, age of victim and other important circumstances, is often quite different from the percentage distribution of fatalities. For example, one local study indicated that while the majority of fatal automobile accidents occurred between intersections, the majority of all automobile accidents occurred at intersections. Conclusions based on fatalities only may be unsound. A second limitation is that the Census Bureau mortality statistics indicate only the general fact that a certain number of persons have met death in automobile or other vehicular accidents. The victims are classified by age and by sex, but there is absolutely no information as to the causes or circumstances of the accident.

2. The police department in every sizeable city collects some sort of information on street accidents. These police systems differ greatly as to the percentage of cases that are reported, the completeness of the reports, the value of the tabulations prepared by the department, and the use made of this information for preventive purposes. Some of the larger city police departments are now doing an excellent job on all these counts while in other cities the reports are valueless.

3. In a very few states where the motor vehicle department has an efficient statistical bureau and a law requiring the reporting of all motor vehicle accidents, the reports of this state bureau are of the greatest value.

4. The insurance companies collect detailed reports on many thousands of automobile accidents, but with one or two exceptions this information has not yet been put to any public use.

5. Unofficial organizations, usually local, have sometimes attempted to compile accident information from newspaper reports and other unofficial sources, but obviously under a large handicap. Such organizations have, however, frequently been very effective in encouraging the use of up to date methods by the local police department, and have assisted in interpreting and making practical use of the resulting information.

THE STANDARD ACCIDENT REPORTING SYSTEM

The Statistics Committee of the National Safety Council, in preparing its annual reports on accidents in general, and automobile accidents in particular, came to the conclusion several years ago that it would be necessary if progress was to be made in accident prevention, to develop a "traffic accident registration area" of as many states and cities as possible, in which the facts of such accidents would be reported on a uniform basis, just as all deaths are now reported to the Census Bureau from a "registration area" including nine-tenths of our population. It was felt that the only practicable sources for such reports were: (1) state motor vehicle departments in states having such departments, or where laws permitted the establishment of them; and (2) the city police departments in states without a motor vehicle department—the great majority at present. Accordingly the committee, whose membership includes state and city officials engaged in this work as well as statisticians and traffic engineers, formulated the "Standard Accident Reporting System" for traffic

accidents. This system, after only two years of promotional work, is now used by the state of New York and by more than sixty other cities including Chicago, Detroit, and other important places, and covering in all more than 25 per cent of our national population. In addition the states of Massachusetts, Connecticut, and Rhode Island have for several years produced excellent statistical reports on motor vehicle accidents which are largely comparable with the data yielded by the "Standard System." Under new legislation it is expected that in January, 1928, the standard system will be put into use in Pennsylvania, California, and perhaps other states. The addition of these states and other cities will probably bring the "traffic accident registration area" up to about one-half the population of the United States.

The adoption of the system, which follows closely the recommendations of the National Conference on Street and Highway Safety, has been hastened by the official endorsement of the International Association of Chiefs of Police and the Accident Committee of the Highway Research Board.

What information has this reporting system disclosed? Among other things we have found that 66 per cent of all persons killed in automobile accidents are pedestrians. Most of the remainder are drivers or passengers, although a few are riders of bicycles or horse vehicles. Thirty per cent of all the victims are under fifteen years of age, and nearly all of these are pedestrians. Of the persons receiving non-fatal injuries in 1926, 54 per cent were pedestrians, 41 per cent were occupants of a motor vehicle, and 5 per cent were riding on or in other vehicles. Any city or any state, comparing its own record with these and other national averages, can easily see, for example, whether its pedestrian problem is greater or less than the average; whether it has an unusually high percentage of accidents at railroad grade crossings, and whether it is particularly necessary to educate in safe habits those in any age group.

TRAFFIC PEAKS AND ACCIDENT PEAKS

Another type of information, so far available only for particular communities, is the distribution of accidents over the different hours of the day, and especially the distribution of accidents in relation to the distribution of traffic flow. In the cities of Chicago and Grand Rapids data are available showing the percentages of traffic flow and of traffic accidents that take place during each hour of the day. The curves for the two cities show a striking similarity. In both, the accident curve crosses above the traffic curve at 4 P. M. —that is, before 4 o'clock the number of accidents is smaller in proportion to the volume of traffic, but after 4 o'clock the number of accidents is greater in proportion to the volume of traffic. In Chicago especially there is a peak of traffic at the morning rush hours, 8 to 10 o'clock, but relatively few accidents occur. The traffic in the evening rush hour, 5 to 6, is only slightly greater than in the morning, but the accidents are more than three times as many.

Of equal interest is the relative accident liability of various classes of vehicles. From the data yielded by the cities using the Standard Reporting System, it is found that private passenger cars were involved in 69 per cent of all the motor vehicle accidents, whereas these cars constitute over 86 per cent of the total registration. Trucks and commercial vehicles were involved in 16 per cent of the accidents although they make up only 12 per cent of the registration. For taxicabs and buses the figures are 13 per cent and one-half of 1 per cent respectively and

for motorcycles, 2 per cent and 1 per cent respectively. It is, of course, illogical to draw conclusions from these figures without taking into account the fact that the average taxicab, for example, covers a much greater daily mileage than the average private passenger car. An accurate estimate of this factor is one of the jobs that still remain for our statisticians.

GETTING AT THE REAL CAUSES

The Standard Accident Reporting System also yields valuable information as to the circumstances surrounding the accident. These circumstances are grouped under such headings as condition of vehicle, condition of road, what the motorist was doing, what the pedestrian was doing, weather, light, etc. In New York State during 1926 out of nearly 36,000 pedestrians injured or killed, more than one-third were children playing or otherwise occupied in the street between intersections. The next largest classification, more than one-fourth of the total, was adults in the street between intersections—commonly termed "jaywalkers." At intersections where there were no signals 7,857 persons were injured or killed in crossing; 1498 while crossing against the signal; and 741 while crossing with the signal. The first and third of these items indicate carelessness or worse on the part of the motorist, while the second indicates even more serious error of the pedestrian himself. The other items of this annual tabulation, which may be obtained from the Bureau of Motor Vehicles, at Albany, are equally enlightening. The other jurisdictions using the standard system or its equivalent are obtaining similar information as to the nature of their problems.

A necessary part of any such statistical system is a series of spot maps on which the fatal and serious cases are marked by pins or dots so as to show up the dangerous streets and intersections. If any one location is found to be having an epidemic of accidents the original reports thereof are consulted, and these often give the clue as to the engineering or other remedies needed. Street accident prevention is partly a matter of general legislation and general education, but it is also partly a matter of studying the specific places where accidents are happening, and the specific groups of people who are involved, and working out specific remedies to fit.

PSYCHOLOGICAL STUDIES NEEDED

In the study of accident causes the final step—the study of the personal element—has yet to be taken. There is little doubt that some persons are more susceptible to accidents than others and that every one is more liable to accident at certain times than at others. In this field of individual susceptibility some elements, such as poor eyesight or hearing, are obviously a factor, though we do not yet know how large a factor they may be. Other elements, such as those which constitute or cause "inattention," have received little or no study, at least in connection with automobiles. Scientific men agree that there is vital need today for intense scientific study—a combination of the psychological, the physiological and the engineering—of the persons who are involved in serious or repeated accidents, or in serious or in repeated violations of traffic rules, to ascertain if possible whether there are any mental or physical characteristics common to this group of persons and in which they differ from the general run of people. The investigators who will first make a practical study of this sort, leading to concrete conclusions, will be performing a great service to the safety movement.

Traffic Regulations to Prevent Accidents and to Expedite Fluid Traffic Movement[1]

An Analysis of Accident Causes and Some Suggestions for Their Correction

By Guy Kelcey
Manager American Gas Accumulator Company

SUBJECT to slight variation, accidents in all cities and towns conform to the following percentages:

Not over 10 per cent of traffic accidents occur in the business area.

Ninety per cent of traffic accidents occur outside of business areas.

Usually not over 2 per cent of traffic deaths occur in business areas.

In Detroit in 1925, 51 per cent of all business area accidents occured after business hours. Based on the number of persons and automobiles on the streets during and after rush hours, it was about fifteen times safer to cross the street or to drive through heavy traffic than after rush hours when traffic was light. In fact, it is generally true that as congestion increases the hazard decreases.

Approximately 75 per cent of all accidents are at street intersections.

Accidents elsewhere (between intersections), 25 per cent.

On the basis that the length of a city block is eight times the distance within intersections, the likelihood of an accident to an automobile is twenty-four times greater for each one hundred feet traveled within intersections than for each one hundred feet traveled between blocks.

Expected Versus Unexpected

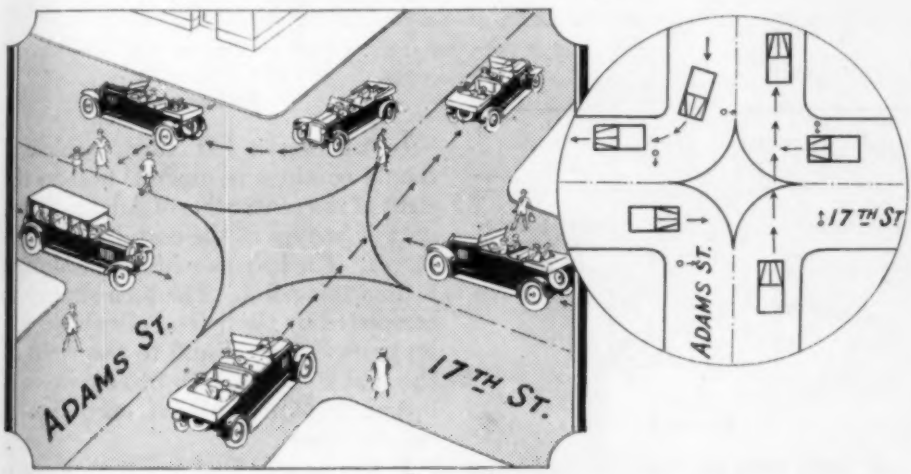


Figure 1

[1] The collection of accurate data on accidents may establish other figures than are here quoted. Those given in this outline are an average of conditions observed in many communities and are based on statistics which are often incomplete. Figures used, therefore, are not vouched for as accurate. They will serve a very useful purpose if, in their proof or disproof, the collection of accurate data on accidents is inspired.

A traffic accident is not a premeditated act. An accident results only when something unexpected or unlooked for occurs.

If street intersections are studied from this point of view, it is discovered that:

Through traffic usually continues in its proper channel and drivers can judge to a nicety what other drivers will do—each does his part. Accident records do not show a heavy proportion of accidents from straight-through movements of vehicles.

Right turns are usually made under control and in channel so that accidents from this cause are not common.

Left turns must then be the cause of most intersection accidents.

Certainty is present in the first two cases. The left turn introduces uncertainties which are shown in the following pages.

KEEP TO THE RIGHT

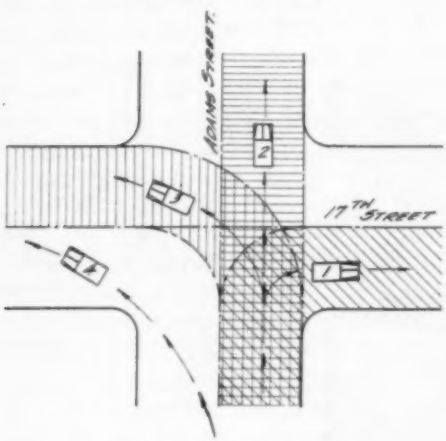


FIGURE 2

If there were no rule "Keep to the Right" our streets would be impassable. This rule divides the street into two parts; traffic goes north, for example, on one side of the street, and south on the other.

With this rule in mind, it will be clear that vehicle 1 in the illustration turning right, or vehicle 2 going straight through, are not likely to get out of their proper channels.

Vehicle 3, turning left, continues in its proper channel in Adams Street to the near curb line of 17th Street and enters on the right side and in proper path in 17th Street.

Vehicle 4, making a short left turn, gets into the wrong channels of both Adams and 17th Streets and therefore violates the rule "Keep to the Right."

PROPER LEFT TURNS

FIGURE 3

In making a left turn, vehicle 1 should continue in channel and to the right of the center line of Adams Street until it arrives at the curb line of 17th Street. The turn should not be started behind this point. The turn should be completed by the arrival of vehicle 1 in its proper channel and to the right of the center line of 17th Street where it intersects with the west curb line of Adams Street.

It will be seen that this movement is made to the right of a curb line joining the two center lines from a point of their intersection with the curb lines. When all of the center lines are thus connected an area is formed within the

intersection through which all left turns should be made.

LEFT TURNS ANALYSIS CHART [2]

City, Unionville, N. J.
Location, Brown and White Streets
Date, Aug. 26, 1926.
Time, 4.15 P.M. to 4.25 P.M.

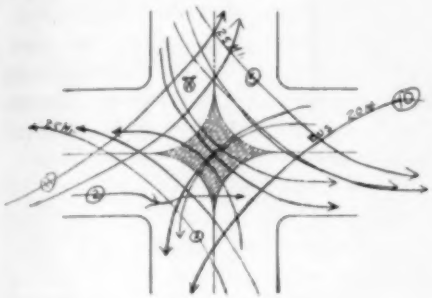


FIGURE 4

It will be seen in this drawing that, connecting the street center lines with a curved line, an area is formed in the center of the intersection. If traffic turns left through this area, it is moving correctly. If it turns outside this area it is moving incorrectly and in wrong channels.

Results	Number	Per Cent
Vehicles turning left	13	100
" " correctly . .	5	38½
" " incorrectly	8	61½

REMARKS.—Vehicles 1 and 2 nearly collided. Vehicles 1, 5, 10 and 11 turned at too high speed. No. 11 approaching from rear at 20-mile speed almost struck pedestrian A.

Driver 1 is making a short left turn and is going faster than he should.

Pedestrian A saw car 1 coming when he stepped from the curb, but expected it to pass behind him, and turned his attention to car 3 as his next danger. He just escapes.

Pedestrian B looking, as he should, in the direction of car 2, steps directly into the path of car 1.

Driver 3 is looking in the direction of car 2 and sees car 1 almost too late to avoid an accident.

In each case drivers and pedestrians were looking in another direction and

VEHICLES MAKING SHORT UNEXPECTED LEFT TURNS AND STRIKE FROM BEHIND

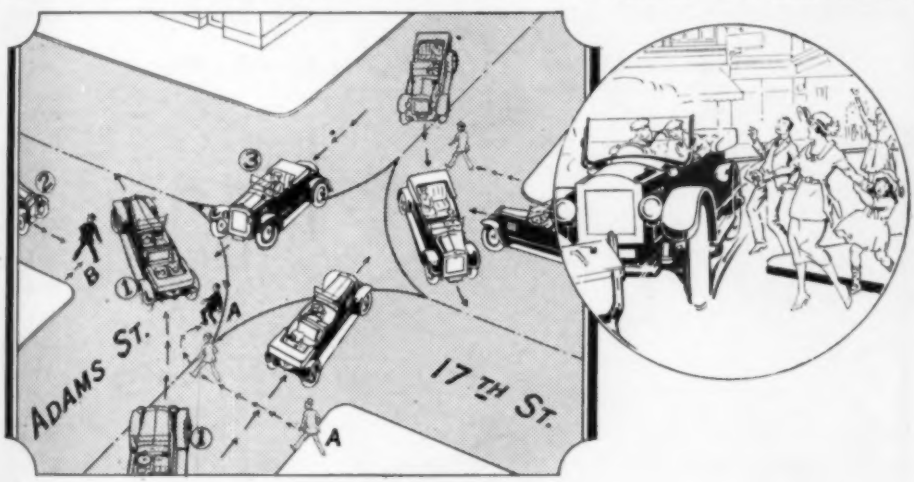


FIGURE 5

[2] It is suggested that the reader prepare blank charts and check improper left turns and the disorders they develop.

had no reason to expect the dangerous movement of car 1.

Vehicles making a short left turn move on the wrong sides of two streets and always strike from behind.

cars in other directions, just save themselves.

Driver 2 deflects left to avoid accident and car 3, in dodging him, collides with car 4.

THE DANGEROUS DRIVER IS THE ONE WHO STARTS THE DISORDER FROM WHICH AN ACCIDENT RESULTS

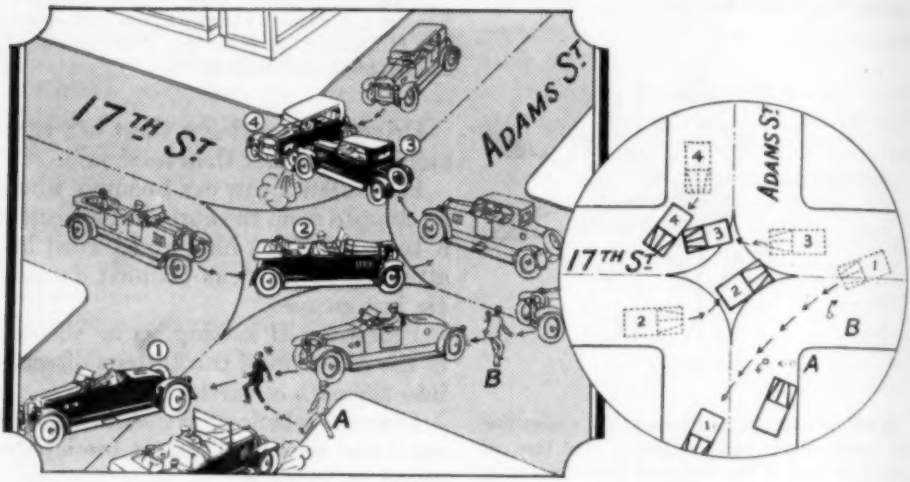


FIGURE 6

Car 1 cutting the corner at speed started all the trouble.

One car is forced to the curb and two pedestrians, A and B, looking for

Driver 1 goes his way and driver 3 will be charged with reckless driving.

Car 1, in cutting short, started a general disorder and unexpected move-

MAKE THE CORRECT PATH THE ONLY POSSIBLE ONE

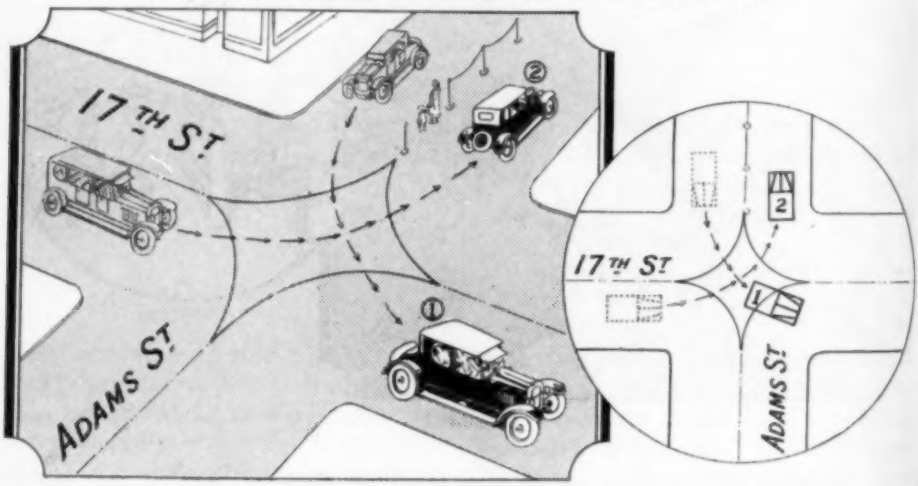


FIGURE 7

ments which resulted in an accident. Even if there had not been an accident, driver 1 created a confusion which frequently leads to accidents.

Suppose that stanchions are placed in a row, as shown in Adams Street. They compel driver 1 to stay in his proper channel until he comes out to the curb line of 17th Street. Starting to turn left from this point, he finds it hard to enter 17th Street, except through the correct channel into that street. In fact, the faster he moves, the surer he is to make the turn correctly.

In the same manner, driver 2 finds he must continue in channel to the curb line in 17th Street in order to make the easiest turn into Adams Street. If he cuts short, he is blocked by the row of stanchions.

Both drivers find that improper left turns are blocked and correct turns the only ones they can make conveniently.

This treatment would correct the left turns into and out of that side of Adams Street. It would have the same effect as the row of stanchions on the other side of the street.

The basic requirements of a signal to regulate the movement of traffic and to keep it orderly will be met if a light is placed on the barrel at night. This light will serve two purposes. It will warn traffic of approach to a point of danger and will indicate the presence of and protect the barrel from being struck.

The completed treatment shown corrects all left turn movements within the intersection, and keeps all traffic in good order and in proper channels.

The preceding illustrations have established the following principles of traffic:

Traffic may be expected to take the easiest and most convenient course.

OBSTRUCT WRONG MOVEMENTS WITHOUT INTERFERING WITH PROPER PATHS

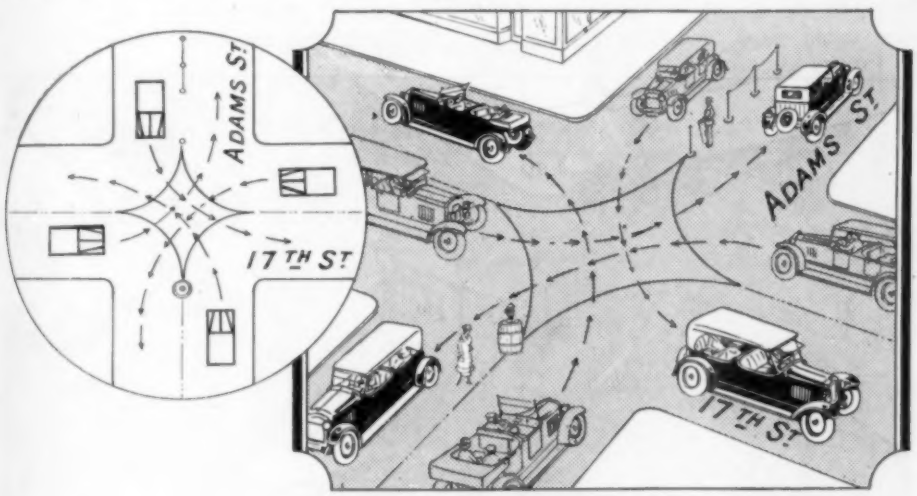


FIGURE 8

Now suppose that a barrel or similar obstruction is placed in the throat of Adams Street and on the curb line of 17th Street opposite the row of stanchions.

The line of least resistance that produces unexpected traffic movements, disorder and accidents at an intersection, is the short left turn.

To prevent short left turns and

attendant disorders which cause accidents, it is necessary to place signals so that they block out or obstruct improper movements. This can be done without interfering with proper traffic paths.

The treatment shown (Fig. 9) employs a signal in one throat of Adams Street to warn traffic in all directions and a row of marker buttons which produce the effect of a curbing, in the opposite throat. This treatment is

ACCIDENTS ARE THE PRODUCT OF DISORDER

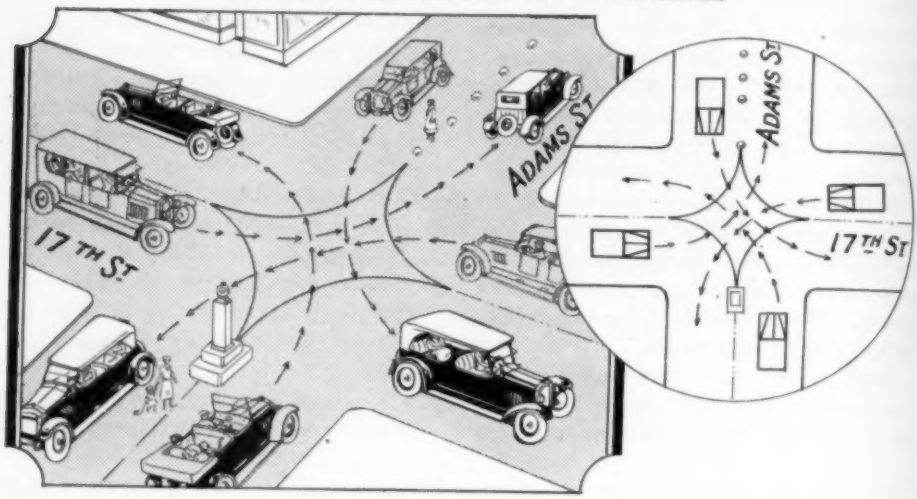


FIGURE 9

SAFE ZONES FOR PEDESTRIANS

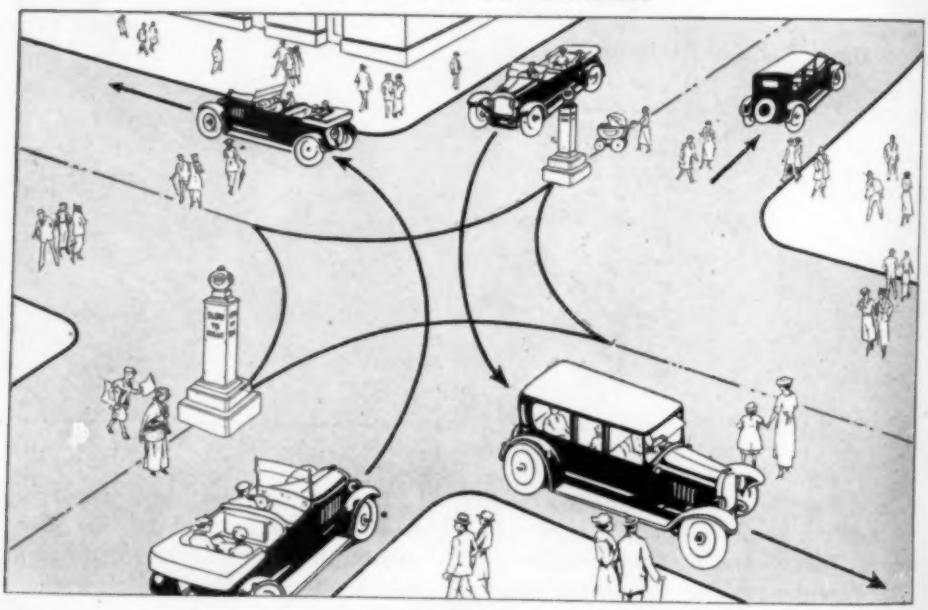


FIGURE 10

very effective at many locations and can be installed at low cost.

In some street intersections, one signal is not adequate and two must be placed in service.

Note the safety zone or refuge value of the installations to pedestrians crossing the streets through traffic.

Signals for such work must be properly designed to meet the conditions under which they operate and should be equipped with flashing lights. If not designed and placed correctly, however, they are likely to be ineffective and often less than useless.

Properly placed, signals to regulate traffic as shown, will pass more vehicles and pedestrians with safety than before treatment. In fact, the reduction of accidents usually exceeds 90 per cent.

Signals which regulate traffic movements without the Stop and Go feature place the "emphasis on the GO and not the STOP," [3] an important point, since unnecessary delays to traffic place an excessive burden of cost on the community.

When two streets intersect at an acute angle, there are two problems.

The short left turn which is more inviting and more dangerous at such intersections.

Traffic intersects rather head on at an acute and dangerous angle.

When two vehicles approach each other from an angle, neither driver knows accurately what the other will do. Both usually do something not expected by the other, and neither driver is able to judge distances, speeds or clearances. The truth of this statement may be tested by walking diagonally across a street through traffic.

In the illustration, car 1, cutting short around a blind corner, saw car 2 just in time to avoid an accident. Pedestrian A, looking out for car 2, escapes being hit by running.

Driver 3 is moving out of what appears to be the proper channel of Congress Street. He and driver 4 become confused because of the angle at which they approach each other and neither knows quite what to expect of

ACUTE ANGLE STREETS ARE ACCIDENT BREEDERS

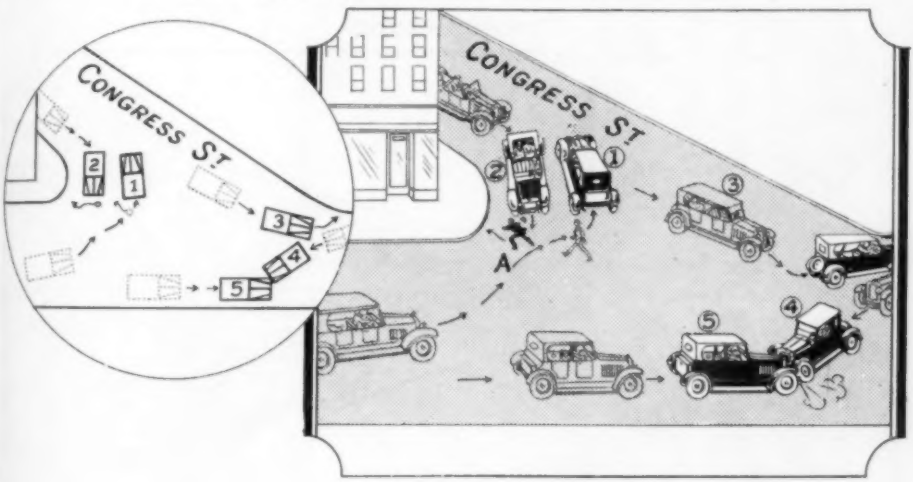


FIGURE 11

[3] Miller McClintock

the other. In dodging, driver 4 collides with car 5.

CHANNELIZE TRAFFIC

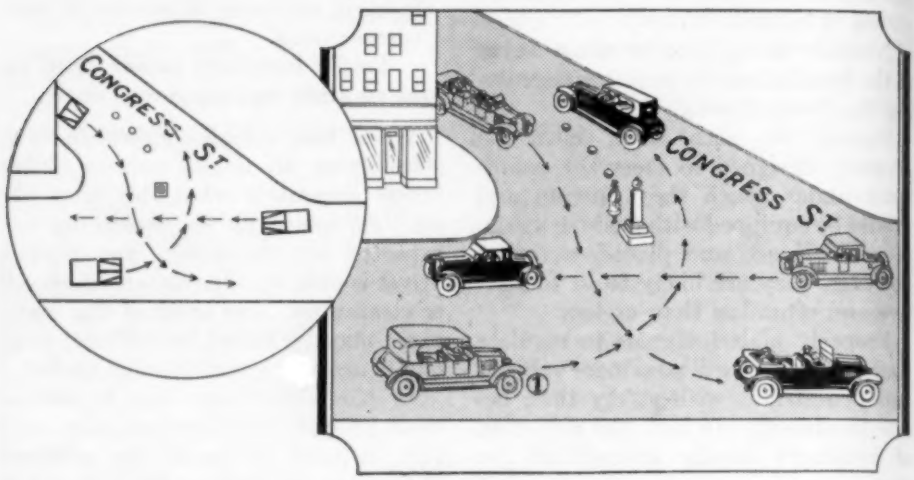


FIGURE 12

In applying treatment to prevent accidents and disorder where streets intersect at acute angles, it is necessary to:

Keep traffic in proper channels in each direction.

Readjust the channels so that traffic will intersect as nearly as possible at a right angle.

Provide a safe zone or refuge for pedestrians, who are very much in need of such protection.

The illustration shows such a treatment. The traffic moves freely and properly in each direction and pedestrians are safeguarded. Improper traf-

TRAFFIC DISORDER

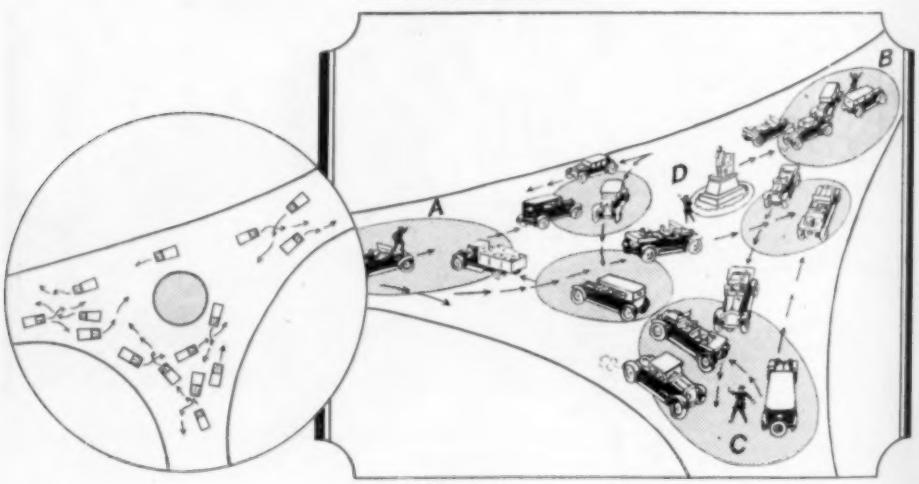


FIGURE 13

fic movements are blocked out by a flashing beacon and marker buttons properly placed.

A typical large area traffic problem is shown. It required four officers to handle this intersection in a large city park. Accidents were frequent and there was much confusion and congestion. The following points should be noted:

Traffic intersected at sharp angles, in some cases almost head-on.

With plenty of space traffic tends to roam. In this case each driver suited his convenience as to routing, thus increasing the confusion.

There were six major intersection areas (shown shaded), which formed a series of dams in the path of the main streams of traffic. As a matter of fact, traffic seemed to come from and to go in all directions.

This problem was serious since there were no definite channels for traffic. No one knew what the others would do and the resulting disorder caused accidents, confusion, and, during rush hours, serious congestion. Four officers stationed at A, B, C and D were required to handle it.

The problem was solved and all four officers transferred to other duties in 1921. In spite of greatly increased traffic, it remains solved and accidents and congestion have been eliminated. Three triangular areas were installed with flashing beacons on the traffic approach ends.

These installations limit traffic to definite channels.

Wrong movements are obstructed without interfering with proper paths which were made most convenient.

Six traffic intersection points are reduced to three which are at right angles and out of the way of traffic moving along the sides of the area.

Pedestrians have safety zones for their protection.

Everyone knows definitely what to expect of everyone else.

This simple treatment, without an officer, passes more vehicles without accident than when the same traffic was handled by four officers prior to 1921.

The next point depends upon a clear understanding of traffic regulation and control.

Traffic *Regulation* is illustrated in

TRAFFIC ORDER

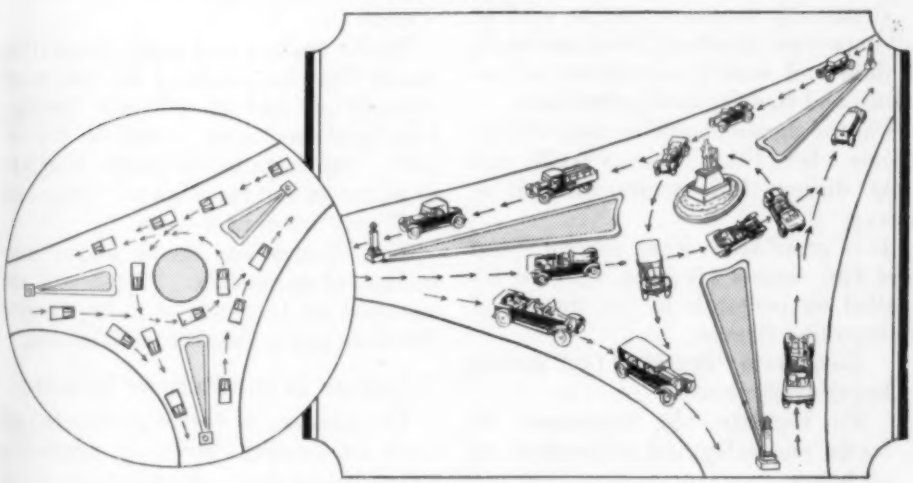


FIGURE 14

previous pages. It may be defined as means by which the movement of traffic is confined to proper channels and disorderly movements prevented. A signal to accomplish this is a *regulating* signal.

To be turned on as flashing signals during light hours, thus allowing a continuous safe movement of traffic without stopping.

So that the signal lights may be placed in the most advantageous

INSTALL STOP AND GO SIGNALS
TO *REGULATE* AS WELL AS TO *CONTROL* TRAFFIC

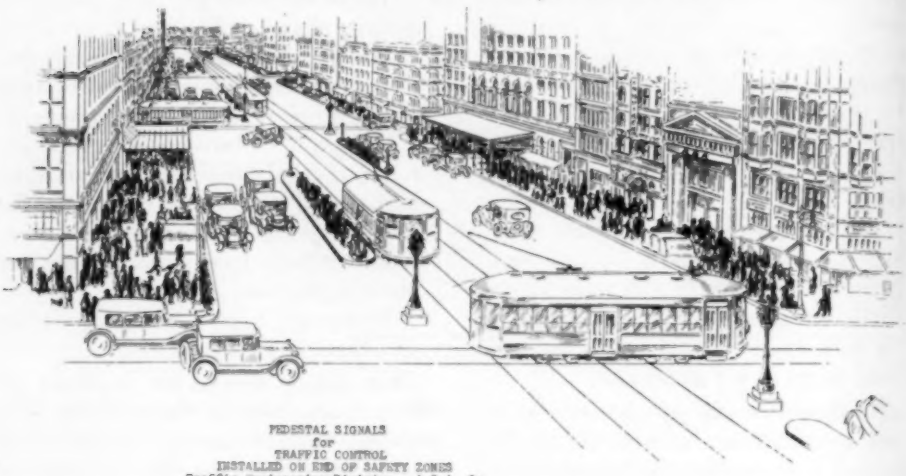


FIGURE 15

Traffic *Control* refers to means by which traffic may be halted or stopped. A Stop and Go signal is, then, a *control* signal.

Regulating signals should be used at all important intersections to maintain a fluid and orderly movement of vehicles and to safeguard pedestrians.

Control signals should be used only at points where there is heavy traffic and only during those hours when it is heavy.

It is urged that, when control (Stop and Go) signals are used, they be installed on pedestals in the throats of intersecting streets:

To operate "Stop and Go" during heavy traffic hours.

To regulate the movement of traffic and safeguard pedestrians at all hours.

position, *i.e.*, in the path of traffic and low enough that the beams of light may be directed as nearly as possible on a level with the drivers' eyes.

Traffic control and traffic regulation would thus be provided for the same expenditure and an efficient twenty-four hour treatment would be the result. The installation would regulate at all hours and function as "Stop and Go" only when necessary.

The illustration above shows one method of doing this. The signals are installed on the ends of safety zones. Previous pages show other methods.

SIGNALS IN THE PATH OF TRAFFIC

The analysis of traffic accidents and their prevention, given in preceding pages, is based on a careful study of the

major causes of accidents at street intersections.

The conclusions reached might not be entirely convincing if they were based on assumptions or theories. Each step in the analysis has been carefully checked by many observations of traffic movements at street intersections in the United States and other countries, over a period of years. In addition, thousands of difficult traffic problems have been successfully treated and accidents eliminated through the application of the principles outlined.

There has been a strong movement in some communities to remove all signals, which are placed in the path of traffic, from the streets. This has developed because such signals are believed to interfere with traffic and because they are sometimes struck and motorists injured.

Many communities, however, take the stand that the more a signal is hit the more apparent the need for it. It is considered that if a motorist strikes an effective signal he will certainly hit pedestrians who carry no lights, or other vehicles with lights less bright than the signal. In fact, it is considered that a motorist who collides with a signal is one of that small group who cause most of our traffic troubles. A check of the number of motorists striking signals in various cities indicates that over 75 per cent were under the influence of liquor.

Experience has shown that signals properly placed in the street do not interfere with traffic, but are an aid to its fluid and safe movement. In fact, congestion is often cleared up at an intersection by such treatment.

It is therefore suggested, for the serious consideration of traffic authorities, that the ultimate solution of traffic accidents at street intersections is the elimination of disorderly movements and the channelization of traffic. This can only be accomplished by signals correctly placed in the throats of intersecting streets.

Grade Crossings

The Money Value of a Car-Minute

By Fred Lavis

Consulting Engineer, New York

MUCH has been said and written about the dangers of grade crossings, especially those of railways with highways. Safety campaigns have been instituted both by the railways, highway officials and automobile associations, and fervent appeals to cross such crossings cautiously have been made through the medium of posters, vividly portraying the results of carelessness (on the part of the users of the highways) at these points of intersection.

Much ingenuity has been displayed in devising warning signals and in the development of approaches to such crossings so that those using the highways may not only be warned, but that they may have the warnings so emphatically brought to their attention that only the most reckless could ignore them.

Many hundreds of millions of dollars have been spent in the elimination of such crossings, by separating the grades, at points where the traffic of the railway or the highway or both has reached the stage where the resulting delays and dangers have seriously interfered with the operation of the railroad or the business of the community using the highway or street.

Economics of Grade Crossings

From time to time computations have been made of the capitalized value of the annual savings due to the savings in wages of watchmen, flagmen, or gatemen at such crossings, in order to compare this value with the cost of their elimination, but little if any attempt has been made to investigate the far more important subject of the economic losses due to delays at such crossings; nor has the matter of economics of grade crossings of important highways with other highways received the attention warranted by the recent development of vehicular traffic. It is this phase of the subject which the writer desires to discuss briefly in this article.

Some three years ago, the New Jersey State Highway Commission[1] found itself confronted with the problem of providing additional means of caring for the very large volume of traffic passing through the metropolitan area of northern New Jersey, just west of the Hudson River and New York City, and the writer was engaged to help work it out.

One branch of this traffic between New York and points to the south and west, that is, to the New Jersey shore resorts, to Atlantic City, and on the main route toward the south via Trenton and Philadelphia (Lincoln Highway) necessarily has to pass through the cities of Jersey City, Newark and Elizabeth, the streets of which are only barely adequate to take care of local business and traffic, and entirely inadequate to care also for this superimposed load of through traffic.

An entirely new through route through this area was therefore planned, and is now under construction, at a cost of over $30,000,000, its length be-

[1] Major General Hugh L. Scott, Chairman; Major William G. Sloan, State Highway Engineer.

ing about 13 miles. This highway is designed primarily as a factor in transportation, for the purpose of carrying with facility a very large volume of traffic, estimated at 20,000,000 vehicles per annum, and eliminating the disturbance to local traffic which this through traffic would otherwise cause.

It will be realized, therefore, that the most careful consideration was necessary in the determination of the economic factors which might govern the location and design of this highway, to the end that a proper balance might be struck between the costs of construction and the savings in costs of operation of the vehicles using it. The following is a rough illustration of this.

The costs of operation of a commercial motor vehicle may be divided into these items:

1. Interest on capital invested.
2. Depreciation.
3. Insurance.
4. Drivers' wages.
5. License fee.
6. Gasoline.
7. Oil.
8. Tires.
9. Repairs.
10. Washing and cleaning.
11. Battery.
12. Overhead.

It will be readily seen that Items 6, 7, 8, 9 and 11 are directly affected by and generally proportionate to the distance traveled by the vehicle, while the others are not.

It has been determined that for a traffic consisting of 50 per cent of heavy trucks, 25 per cent of medium weight trucks and 25 per cent of private cars, the average cost of operation in and around New York City (Items 6, 7, 8, 9 and 11 as above), is about 12 cents per mile.

If, then, we assume a traffic of 20,000,000 vehicles per annum, the savings in the costs of operation of these vehicles due to shortening the route by a mile would be $2,400,000 per annum, and capitalizing this at 5 per cent, it is evident that it would be economically sound to spend $48,000,000 to save a mile of distance. This holds true practically in the same proportion for any other distance, at least up to about two miles, and the amount which might therefore be economically spent to save a single foot of distance is in this case about $9000.

Proceeding in a similar manner, an attempt was made to determine the other economic factors which affected or might affect this traffic on the main highway above referred to and among others, those at an assumed crossing with another highway at grade.

As a matter of fact, this main highway is being built so that it will have no crossings at grade with other highways, connection being made with such important streets or highways as are crossed, by means of ramps entering and leaving the main highway in the direction of the flow of traffic. The justification of this expense was, however, first determined by the methods above indicated, and it may be of some interest, especially at this time when almost every city of importance is struggling with some problem of street or highway congestion, to briefly review the methods used to determine the economic losses due to a crossing at grade of this highway, carrying 20,000,000 vehicles a year, with another main highway.

For the purposes of the computation, it was assumed that the traffic conditions at the crossing were such that traffic on the main highway could proceed for three minutes and then be interrupted for one minute.

There are two factors which have to be taken into consideration in calcu-

lating the economic losses at such a crossing.

First, there is the actual loss to the operators of the vehicles due to the delay.

Second, there is the loss due to the reduction in the capacity of the highways to carry traffic.

Taking now, the first of these two factors, it was ascertained that for the class of traffic using the main highway, the cost of operating the average vehicle for one minute is 2.2 cents.[2]

It is evident, of course, that the delays at such a crossing vary at different hours of the day, on different days of the week and in different months of the year. At times of maximum traffic, which may be from five to eight hours per day, the maximum delays occur, whereas at certain other hours the traffic of the two roads might and usually would pass with hardly any delays.

Numerous diagrams, based on actual counts, showing the fluctuations of travel throughout the twenty-four hours, for each day of the week and each month of the year, have been drawn, and provide sufficient data for general assumptions for the purposes of these calculations.

Taking all these factors into consideration, therefore, it was ascertained that the effective losses at the crossing under consideration amounted to some 7,000,000 car-minutes per annum, which, at 2.2 cents per minute, indicated an annual loss of $154,000, which, capitalized at 5 per cent, indicated further that over $3,000,000 might profitably be spent to avoid this loss.

Then, taking the second factor above referred to, it will be recalled that the highway we are considering is expected to be called on to carry, at certain hours, traffic to its maximum capacity. Any reduction of this capacity therefore represents an economic loss.

[2] See discussion at end of this article.

It will be easily apparent that if 20,000,000 vehicles desire to use a certain highway, and that if this highway be so designed that it can carry only 18,000,000, then another route must be provided to take care of the other 2,000,000, and that this is a very definite item of expense.

If the expenditure of, say, $1,000,000 would provide sufficient increase in the capacity of the first route, and it would cost, say, $3,000,000 to provide a new route, then the former (leaving out other considerations) would be the proper thing to do. The economic problem is the determination of the effect of the physical characteristics of the route and the cost of modifying or changing them.

Based on similar calculations to those which were made to determine the losses to individual cars on account of the delays, it was ascertained that, taking into account only the loss of capacity due to the delays at times of maximum demand, the capacity of the highway was reduced by approximately 12 per cent, and in view of the fact that this particular highway is costing some $30,000,000, this loss in efficiency may be valued at $3,600,000.

Taking these two items together, it may therefore be assumed that a sum of approximately $6,600,000 might profitably be spent to avoid such a crossing as that under discussion.

Of course, if there were a series of such crossings, this sum would not be multiplied by the number of crossings, so it was further calculated that, if there were several of such crossings, spaced at approximately equal distances apart and controlled by synchronously operated signals, the amounts which might be spent to avoid them might be assumed to be:

One crossing	$6,600,000
Three crossings	7,200,000
Five crossings	8,000,000

This, in general, without going into details of the mathematical formulae and computations necessary to arrive at the results given, indicates the manner in which this problem may be approached from an economic standpoint. In view, however, of the general lack of appreciation of the value of small fractions of time in the operation of motor vehicles, it may perhaps be of interest to append the following detailed discussion showing how the value of a "car-minute" was worked out for the highway in question:

MONEY VALUE OF ONE CAR-MINUTE

In the following discussion[3] the money value of a car-minute is considered separately for trucks, smaller commercial vehicles and non-commercial vehicles or so-called pleasure cars.

Under trucks are included trucks of from two, to two and one-half tons' capacity and over, and busses of the heavier types.

Under smaller commercial vehicles are included lighter busses and delivery cars, taxicabs, passenger cars used in the service of the federal, state and municipal governments, by contractors, Public Service corporations, salesmen, and others.

A. Trucks

A truck is a commercial plant, kept in operation during a daily period of, say, eight hours during every working day of the year or, say, for 300 days. The daily cost of such a plant is the sum of the cost of a number of items, some of which are to be taken into account only when the plant is actually running, while other items must be charged during the whole period of the working hours, whether the plant is in operation or not.

[3] Prepared by Mr. S. Johannesson, Designing Engineer, New Jersey State Highway Commission.

In the case of a motor truck, the items which make up the cost of operation may be classified as follows:

1. Interest on capital invested in truck.
2. Depreciation of value.
3. Insurance.
4. Drivers' wages.
5. License fee.
6. Gasoline.
7. Oil.
8. Tires.
9. Repairs.
10. Washing and cleaning.
11. Battery.
12. Overhead.

When the truck is running, charges accrue against all the items classified. If, however, the truck be delayed or stopped during its travel, this prevents the plant from being utilized to its full capacity. During this period no expense for gas, oil, tires, repairs, etc., is being incurred but the other charges, including interest, depreciation, insurance, drivers' wages, license fees and overhead, still continue, and the measure of the values of these is the measure of the cost of the delay or stoppage.

The money value of these items for a truck of about three tons' capacity is estimated as follows:

		Per Annum
1.	Interest; cost of car, $3,000 at 6%	$3,336
2.	Depreciation; life, 5 years	600
3.	Insurance	300
4.	Drivers' wages; 300 days @ $5.60	1,686
5.	License fee	20
		$2,780
12.	Overhead; 20% of items above	556
	Total per year	$3,336
	Total per day	3336/300 = $11.12
	Total per hour	11.12/8 = 1.39
	Total per minute	1.39/60 = .023

It is true, of course, that on account of delays a certain additional amount of

gas and oil will be consumed over and above that necessary to actually propel the car, but this will be a comparatively small amount and to be conservative it has been omitted.

The cost of one minute's delay, during working hours, for what is here assumed to be an average truck, may therefore be taken at 2.3 cents.

B. Smaller Commercial Vehicles

A similar determination of the value of a car-minute for smaller commercial vehicles may be made as follows:

	Per Annum
1. Interest; cost of car, $1,800 @ 6%	$108
2. Depreciation; life, 3 years	600
3. Insurance	200
4. Drivers' wages; 300 days @ $5.60	1,680
5. License fee	12
	$2,600
12. Overhead; 20% of items above	520
Total per year	$3,120
Total per day	3120/300 = $10.40
Total per hour	10.40/80 = 1.30
Total per minute	1.30/60 = .022

Many people express doubt as to whether any money value can be assigned to time lost on the road when this time can be measured in minutes only.

A vehicle may make a certain trip over the road and at the end of its journey be parked in its garage; if it had spent another half hour on the road it would have arrived at the garage so much later, but no money loss would have been incurred.

Another car might, however, be engaged in making regular trips between two points, taking perhaps two hours for each trip. If this car be delayed a half hour on one of its trips this might cause the abandonment of an entire return trip, because it would then not be possible to complete it within the working hours, thereby involving a money loss greatly in excess of that assumed in the above calculation.

Again, a car might be going to a warehouse to pick up a load. It might take a few minutes only to receive the load, but on account of a delay of some minutes on the way it would arrive at the warehouse just as the noon hour whistle blows. The car then might be compelled to waste a whole hour on account of the short delay on the road.

Another truck might, on account of a delay on the road, arrive with its load at the point of destination just when the day's work is over. It would be necessary then either to return with its load, wasting the whole journey, or to pay overtime for the work of unloading.

These cases might be multiplied indefinitely. They are sufficient, however, to indicate the wide range of losses which may be incurred by delays on the highway, as well as the difficulty of arriving at exact values of the losses. It may be recalled, however, that ordinary touring passenger cars cost to hire from $3 to $5 per hour, and a delay of a minute in these cases can easily be seen to have a value of from 5 cents to 9 cents.

C. Non-Commercial Vehicles

Certain cars are used for purposes which have no commercial value and therefore delays are thought to have no value. Suppose, for example, that a man is driving his own car, taking himself and his family for a picnic. It may be of no importance whether he arrives at his destination half an hour sooner or later; in fact, if he arrived early he might spend the half hour in driving around admiring the scenery. In this case, time has no commercial value.

There is, however, another phase of this which deserves consideration. Supposing the man with his car and his family should arrive at the approach to one of the Hudson River ferries and

find that by reason of the long line of vehicles ahead he will have to wait nearly a half hour before he can get onto the boat. The day is hot and close, the scenery is not inspiring and all the family, including himself, is getting irritable. If it were possible then for him, by payment of a fee or gratuity, to move up to the head of the line and drive immediately onto the ferryboat, it is reasonably certain that he would be willing to pay anywhere from 25 cents to $2 or more for the privilege.

The fact is that people driving about for what may be called pleasure want not only to be moving but to move at a desirable rate of speed. Although the opportunity rarely exists to pay for the privilege of driving at the desired speed, nevertheless the willingness to make such payment is present.

It seems proper therefore to assign a money value for delays to pleasure cars also, and according to the considerations above, this value may reasonably be taken at not less than 1 cent per car-minute.

The following values of one car-minute may, therefore, be taken to be approximately as follows, at least for the purposes of this discussion:

	Per Car-Minute
For trucks	2.3 cents
For passenger cars	2.2 cents
For pleasure cars	1.0 cent

Then, in order to establish the average value of one car-minute, it is necessary to determine the number of cars of each type expected to use the highway under consideration, and for this purpose it is assumed that 75 per cent of the cars are trucks, 20 per cent passenger cars used for commercial purposes, and 5 per cent pleasure cars.

Taking the above-mentioned proportion of vehicles, therefore, and applying to them the values per minute as deduced, we obtain a value of 2.2 cents per car-minute.

Playgrounds, a Factor in Street Safety

By Weaver Weddell Pangburn, M.A.
Playground and Recreation Association of America

A QUARTER century ago when the movement for public playgrounds was getting underway, the playground was demanded as a haven from the physical and moral dangers of the street. If it was needed then to protect child life, it is needed ten times as badly today.

This is shown in the statistics of street accidents. In New York City alone, 422 children were killed on the streets in 1926, according to the health commissioner's report. "Thirty-seven per cent of the human lives ended on New York state highways in 1925 were those of boys and girls under the age of fourteen years who were playing in the streets," states Charles A. Hartnett, commissioner of motor vehicles for the state of New York. "Altogether 15,821 children were struck by automobiles for, in addition to the 558 killed, 15,263 were injured."

In the congested residence sections of cities, street hazards exist that were undreamed of before the advent of the automobile. A recreation leader walking home one day with a ten-year-old girl in the Red Hook district of Brooklyn was astounded to hear the child say very casually, "I've been knocked down by a truck twice and once by a street car." Thousands of children have similar experiences.

The age group five to nine inclusive was found to be the most susceptible to injury by automobiles, it was stated by the National Safety Council after an analysis of the deaths of 4500 children in automobile accidents in 1925. Among children of this age group, automobiles alone kill a greater number than any disease except diphtheria. It is this group, therefore, that the playground must serve primarily if it is to be a safety factor.

Playgrounds Are Safety Zones

It may be taken for granted that public playgrounds are safety zones and that they save the lives of many children each day when in operation. There are more than a million persons who use the public recreation fields of American cities daily during the summer season. While on the playgrounds they are safe, for instances of fatal accidents on the playgrounds are rare. The increase in the street accident toll among children does not invalidate the importance of the playground for safety any more than it reflects adversely upon safety education in the schools. While new playgrounds are being organized, automobiles are multiplying rapidly and adding to street hazards.

However, statistical evidence of the life saving value of playgrounds is to date inconclusive. Not many thorough-going surveys of accident conditions near playgrounds have been made. In New York City last summer new playgrounds provided by public subscription were said by the community councils to have reduced street fatalities among children 50 per cent in July. This statement was based on police records.

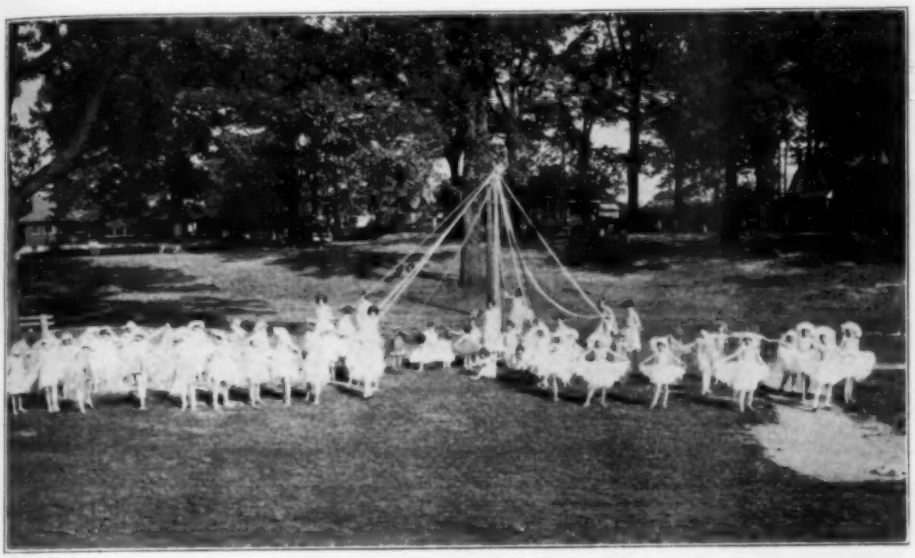
Investigations of engineers of the National Safety Council in a number of cities, for the three year period 1922–24, indicated that cities with the most playgrounds had from one-third to one-

fourth as many child pedestrian fatalities as adult fatalities. In Cleveland, which had seventy-two supervised playgrounds, the ratio was less than 30 per cent; in Toledo, Ohio, very few child fatalities were found within the normal drawing distance of playgrounds. The positions of the twelve playgrounds were indicated on a spot map and circles of quarter mile and half mile radii were drawn about each to indicate their effective area for the different ages of children. Out of thirty-two child fatalities due to automobiles during the three year period, only four occurred within the quarter-mile circle and six within the half-mile distance. Similar conditions were found in Richmond, Va.

Yet in some cities accident spot maps seem to show as many street accidents in the immediate neighborhood of playgrounds as anywhere else, says the Safety Council. It is, therefore, not wise to assume that mere playground *space* will eliminate or reduce accidents in any neighborhood. The playground must be adequately used.

WHERE ACCIDENTS OCCUR

A study of motor accidents to children in Chicago by the Council in 1925 showed that nearly half of the accidents occurred within the block in which the residence of the child was located; two-thirds were no farther away from home than the next block, and three-fourths were within two blocks. This indicated that children were injured while playing in the immediate neighborhood of their homes. The conclusion of the study with reference to playgrounds was: (1) There should be better utilization of playgrounds to keep children off the streets. (2) In such districts, a patrol or convoy system should be installed to bring small children safely to and from the playgrounds in the morning and again in the afternoon, especially during the summer season. (3) The playground system should be extended



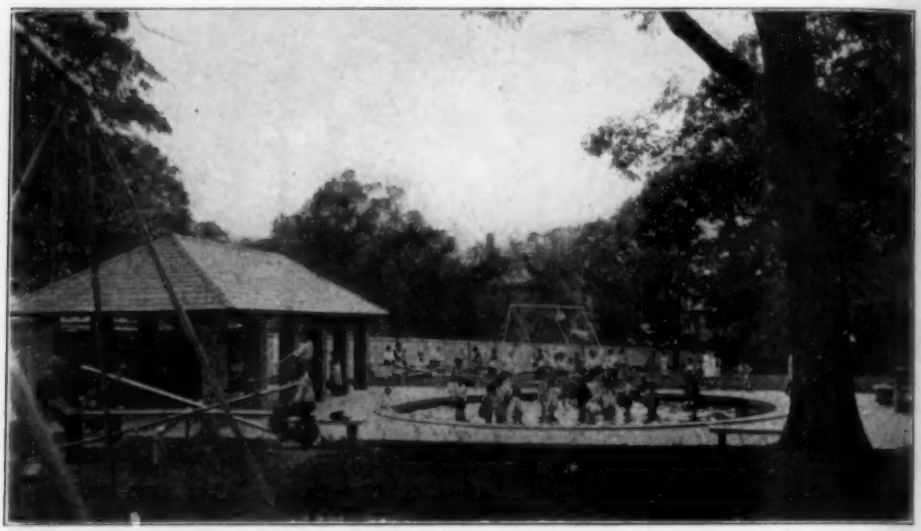
LITTY PARK PLAYGROUND, MEMPHIS, TENN.

to cover areas not already served in congested regions.

BACKYARD PLAYGROUNDS

Children up to five years should play at home under the mother's eye. The backyard should be their play yard. Equipped with a sand box, baby swing, slide, building blocks or other simple equipment, it will keep the small child occupied for hours. In spite of the tendency to life in apartments, the majority of American homes still have backyards which may be utilized for play purposes. Unfortunately, many are still devoted solely to ash cans, rubbish, and the household cat.

In tenement house and apartment house sections, block playgrounds are a necessity for children of five and under. As the City Planning Primer points out, "The need of more public open spaces of all kinds is one of the consequences of apartment house living and must be borne in mind as apartment house areas develop." Some real estate developments, like those of the Bayonne Housing Corporation, Bayonne, New Jersey, provide such block playgrounds. In the tenement districts of New York some backyards have successfully been thrown together to form interior playgrounds. Mothers on all floors of the building may continue their work in the kitchen, casting occasional glances from their windows at their offspring safely at play below.



SHELTERED CORNER OF A PUBLIC PLAYGROUND, NEWTON, MASS., SHOWING WADING POOL, SHELTER HOUSE AND APPARATUS

PLAYGROUND STANDARDS FOR CHILDREN FIVE AND UNDER

Modern recreation standards call for a play lot for every hundred children five years and under. The area should be 5000 square feet. The play lot should, if possible, be accessible to all children without need of crossing the street. In any case, the child should not be expected to travel more than a quarter of a mile to the play lot. The equipment may include sand boxes, baby swings, a small slide, a low drink-

ing fountain, benches and tables for mothers and nurses, and a shelter for baby carriages and for protection against sudden rains. A play house and block building platform may be added.

In a number of cities, special play areas for toddlers are set aside in corners of the regular playgrounds.

A SPECIAL PLAY WORLD FOR CHILDREN UNDER FIVE AT COLT PARK, HARTFORD, CONN.
The equipment consists of playhouses, hammocks, swings, slides and sandboxes, all under a trained leader

Buffalo has such spaces for children, two to seven, on its seventeen playgrounds. In Washington, D. C., there are four separate nursery playgrounds for children under four and toddlers' corners in about eighteen of the larger playgrounds. Hartford has made notable provision for small children. A number of other cities provide specially for the pre-school child.

PLAYGROUNDS FOR CHILDREN 6–12

Playgrounds for this group should be immediately adjacent to the public schools, though special conditions may suggest a more advantageous location elsewhere. Each grade school should have an adequate playground. The effective drawing radius is not more than a quarter of a mile. In thinly populated districts, it may be necessary to accept a half-mile radius. Two hundred square feet should be allowed for each child with a minimum area of two acres for the playground. The equipment may include swings, slides, teeters, possibly a giant stride, horizontal ladder, and gymnasium frame.

A playground ball diamond, tennis courts, volley ball court, jumping pit, 50–75-yard straight-away, and space for free play should be provided. A wading pool and tables with benches for quiet games and handcrafts are also desirable.

PLAY FIELDS FOR CHILDREN 12–15

For this group there should be a semi-play field connected with the junior high school. There should be 200 to 300 square feet per child. Five acres should be the minimum area of the play field.

existence of the fence also adds to the confidence of parents in the safety of the playground.

LEADERSHIP IS ALL IMPORTANT

The most important consideration affecting the value of the playground as a safety zone, and indeed with respect

GROUP GAMES UNDER LEADERSHIP ON A PROVIDENCE, R. I., PLAYGROUND

All playgrounds should, so far as practicable, be so located that children will not have to cross busy traffic streets in going to and from them, according to the resolution adopted at the National Conference on Street and Highway Safety in Washington, D. C., in March, 1926.

Every public playground should be properly fenced to prevent children from dashing from the playground into the street after balls or in the unheeding enthusiasm of the chase. The

to all its functions, is the element of leadership. Conclusive investigations have shown that a playground without a leader is largely futile. It is the director providing by suggestive leadership a constant round of interesting games and other activities that draws large numbers of children from the streets. Without a leader, the playground is little used. Child nature demands not only space but also adventure, activity. If there is no program on the playground, why

shouldn't he turn to the street with its excitement and thrills, dangerous though they are?

BEAUTIFY THE PLAYGROUNDS

Good appearance adds to the playgrounds' drawing power. Children have been known to pass by an ugly playground in order to play on a good looking one. The playground should be made as attractive as possible by landscaping it and planting it with trees, shrubs, vines and flowers.

PLAYGROUND SAFETY PATROLS

In Springfield, Mass.; Memphis, Tenn.; Wilkes-Barre, Pa.; Kansas City, Mo.; Springfield, Ill., and other cities, playground safety patrols of older boys have been formed to give safe conduct to small children in approaching and leaving the playgrounds. In Wilkes-Barre the patrols are instructed to draw up beforehand a plan of the streets around the playground, numbering all the crossings and assigning certain members to specified crossings. Under a special instructor, patrols are taught the right way to get on and off a street car, the bell signals for starting and stopping cars, and the stopping places of cars as required by city ordinance. The dangers of hitching rides and of being struck by cars or other vehicles coming from the opposite direction are taught.

In Kansas City each patrolman is instructed to call each morning at homes in the block to which he is assigned where there are children under ten and to conduct them in a body to the playground. He is also expected to take them home for lunch, bring them back to the playground after lunch, and then take them home again prior to 5 o'clock when the heaviest traffic is under way on the streets. Patrols serve for two weeks. When a boy or girl is appointed to a safety patrol, his or her parents are formally notified that patrols are in no way held responsible for accidents in connection with their duties.

SAFETY EDUCATION ON THE PLAYGROUND

Through games, plays, pageants, talks, songs, rhymes, stories, the making of posters and street crossing models and the formation of safety clubs, the playground has become a successful medium of safety education. How many cities have safety education on their playgrounds is unknown. However, it is safe to say that thus far only a small fraction of the 790 cities reporting organized recreation have launched safety education programs.

The collection of games, plays, and other material on safety suitable for the playground is steadily growing. Two successful games are "The Policeman" and "Traffic." The former is designed to assure children of the ever ready help of the policeman in crossing difficult thoroughfares. "Traffic" was worked out by the Memphis Safety Council to teach children to observe and obey traffic signals. The details of both games may be obtained from the National Safety Council, Education Division, or from the Playground and Recreation Association of America.

SAFETY SONGS AND PLAYS

"Yankee Doodle," "Smiles," "Tipperary," and other well known songs have been adapted to the safety propaganda. Rhymes and jingles carry the safety message to children most successfully. A number of them have been adapted from old nursery rhymes by the Springfield, Mass. Safety Council.

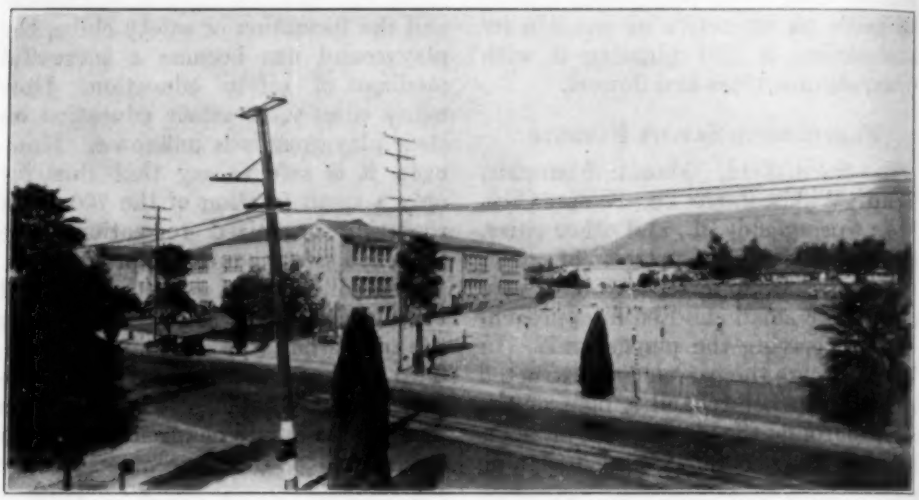
The National Safety Council has made suggestions for posters to be made by the children. Some of the

slogans to letter and illustrate are as follows:

"A. B. C.—Always Be Careful."
"A cat has nine lives. How many have you?"
"A boy on a playground is worth two in a hospital."
"Look both ways before crossing the street."

Keep from playing in the street.
Stop chasing a ball in the street when any automobile or street car is coming.
Keep from riding on the backs of trucks and other vehicles.
Choose a safe place to play—my community playground.

On the pledge card which the child signs to the above effect is a space also for the signature of the parent. Some other cities have "A. B. C. (Always Be Careful) Clubs," whose code is similar to that of the careful clubs. Forty-five thousand children, seven to fourteen, have signed the pledge of the Playground Safety League of the Board of Education playgrounds in Chicago. There are girls' safety clubs at ninety recreation centers in Detroit.



LONGFELLOW SCHOOL, PASADENA, CALIF., AND ITS LARGE ATHLETIC FIELD

"Watch the cop."
"Stop, look and listen."

Two plays obtainable from the Council are entitled "The Runaway Ball" and "Fairies Hold a Safety Court." A very successful safety pageant was held on Chicago playgrounds by the recreation bureau of the board of education last summer.

CAREFUL CLUBS

Safety clubs under a variety of names have been organized by municipal recreation departments. Those on the playgrounds of the Baltimore Playground Athletic League are called "Careful Clubs." Members undertake to do the following things:

Look left and right whenever crossing the street.

BOSTON'S PROGRAM

As a background for the program of safety education on the playgrounds, a series of mass meetings were held in Boston theatres three mornings a week with a program of safety films, a playlet, short safety discussions, and community songs. The children went

to the theatres from the playgrounds under the supervision of the playground workers. Mr. Louis E. MacBrayne, general manager of the Massachusetts Safety Council, has made the following suggestion to playground supervisors: "The supervisor should build her instruction about the fact that 5 P. M. is the peak hour for children's highway accidents throughout the country. At about 4 P. M. traffic increases in volume and speed in order to finish the day's work and return to the garage. Make this fact clear to your children. Every supervisor in charge of a playground should study during the first week of its use the traffic conditions surrounding it."

THE MOVEMENT FOR MORE PLAYGROUNDS

The public's belief in the life-saving value of playgrounds has given impetus to the spread of the playground movement. Five hundred and fifty new playgrounds were laid out last year, bringing the known total in the United States and Canada to 5600. These figures are only for those playgrounds having leadership. There are undoubtedly many thousands without leaders. Counting athletic fields, tennis courts, and other recreation spaces, there are 10,123 separate recreation areas on record in the country, a gain of 1515 over 1925.

Not included in these figures for public playgrounds are the play spaces set aside by realtors in new subdivisions throughout the country. The Playground and Recreation Association of America is aiding this movement by calling the attention of realtors at large to the example of those who are pioneers in donating recreation space, and urging them likewise to set aside land in accordance with the requirements of good city planning.

One example of the new tendency in the real estate development is the Country Club District of the J. C. Nichols Company, Kansas City, comprising about 3000 acres. The recreation spaces that have bearing on the safety of the children are block playgrounds or small parks in the interiors of blocks to be used only by people living in that block, neighborhood park playgrounds, and school sites. For older people there are parks, tennis courts, golf courses, boulevards, and other facilities.

CONCLUSION

Briefly, to summarize and conclude this discussion, the playground may be said to have two functions in relation to street safety. First of all, it is a safety zone; secondly, it is a medium for safety education. Many more conveniently located playgrounds are needed, especially in congested residential districts. As far as possible, they should be so located as not to require crossing streets with heavy traffic. They should be fenced and made as attractive as possible. Skillful leaders are imperative in order that the playgrounds may be fully and wisely used. Incorporated in the playground program there should be games, plays, songs, jingles and rhymes, talks, pageants, the making of posters and the showing of motion pictures and slides that teach safety. Safety patrols, A. B. C. and careful clubs, and safety leagues are effective mediums of safety teaching. Avoiding the costly mistakes made in the older sections of cities, city officials and real estate men should coöperate in securing adequate playgrounds in new sub-divisions in accordance with good city planning. If such measures are carried out, the playgrounds will contribute their share toward reducing the tragic loss of life on our city streets.

The Place of the Street Car in the Modern City Plan

By Lucius S. Storrs
Managing Director, American Electric Railway Association

IN discussing this subject it will be advisable to divide our cities into three main groups. First of all there are the very large metropolitan areas such as New York, Chicago, Philadelphia and a few others whose population is around the million mark or better. The second group comprises cities of fifty or sixty thousand up to seven or eight hundred thousand people, while the third group consists of small cities of fifty thousand or less. It is true that there is no well defined line between these groups and that there are twilight zones in which one group merges into the other. Nevertheless the division will be sufficiently definite for the purposes of our discussion.

The large metropolitan areas are today characterized by congestion, not in one single spot but in many spots or zones within their boundaries, and sometimes, as in New York, by a continuance of congestion over great lengths of roadway. These cities are the commercial and industrial centers of our country and for the purpose of carrying on their business there have grown up huge factories, massive office-buildings, and thickly populated residence districts. Land values are so high as to preclude in almost every instance the possibility of constructing new surface streets to preserve the flow of traffic.

The second group is comprised of cities which have a heavily congested "downtown" district, more or less extensive, tapering off into general business and residence sections, and thence into sparsely settled territory. The present-day congestion in these cities is none the less real because they are smaller, but in some of them at least there is a possibility of relief through the cutting of new streets on the surface.

The third group is comprised of cities which possess only one or two main streets, with residences self-contained and generously spread out over the ground. In such cities, except in so far as they are on highways where inter-city vehicular traffic is heavy, comparatively little congestion is felt at the present time and seldom do they, as yet, call for remedial measures in the form of new thoroughfares.

Adapting Existing Cities to Needs

We are dealing today, not with the problem of how to lay out new cities, but with the problem of how to adapt our existing cities to the needs of the traffic so suddenly and unexpectedly forced upon them, mainly through the use of the automobile. When, within one generation, millions of people, exercising their rights as individuals to the use of city streets, invade those thoroughfares with private vehicles that are lavish in their use of space whether moving or stationary, it is inevitable that great hardship should be wrought upon those whose business depends on the use of a common carrier. To such an extent has this been true that there has been a tendency to ignore the rights of the common carriers upon our highways and to give them only a secondary place in our city planning.

But common carriers are as neces-

sary as streets in our modern city and that policy is shortsighted which neglects their interests. For, while it is true that man transacts his business on foot, the tempo of modern business is such that he must go from place to place with as little loss of time as possible. Public transportation has, in a real sense, made our cities the centers of commerce and industry that they are today, and without such facilities our business life would collapse. We can transact much of our business by the use of the telephone, the telegraph and the mails but personal contact of buyer and seller, of one business man with another, is still necessary, and it is public transportation which, in a large measure, provides this contact. This fact is borne out by many city surveys which show that about 75 per cent of the traffic of our cities today is carried in public conveyances. How much the latter have contributed to the building of the American city it is impossible to say, but the modern economic development which is characterized by dispersion for residences and concentration for businesses would have been impossible without them. Viewed in the light of history we can say that no one would dream of planning a new city without providing ample public transportation facilities any more than he would plan a skyscraper without elevators. The one is just as necessary as the other.

Then how is the problem of providing public transportation for our modern cities to be approached? I have divided cities into three groups because it is my earnest conviction that the treatment of the transportation problem in each group is entirely different. Had this fact been recognized a generation ago we should not now be faced with the necessity for abandonment of street car tracks on the one hand, nor for the provision of expensive new streets to relieve congestion on the other. We entered upon the local transportation problem as though it were the same everywhere and as though the electric street car were the final and only word to be spoken. Just a few years ago in almost every place where a franchise could be obtained tracks were laid down and service inaugurated in the hope that the successful operation of the large cities could be, at least in a measure, duplicated in every community where there were steel rails. The purchase price for some of these franchises was very low and business was prosperous. But each successful venture in a city of some size lured others into the establishment of similar systems in smaller and smaller cities, often with the acceptance of paving and tax provisions that were forever after to hang like a millstone about their necks. Besides this, very few foresaw the possibility of a complete change in price levels, almost over night as time goes, and the necessity of paying twice as much for the materials and labor they used out of a fixed nickel fare that they had accepted in their contract and which had shrunk to half its purchasing power. Many of the pioneers in electric railway construction, it is only fair to say, were quite content with the arrangement of an indefinite ride within the then city limits for a fixed fare; but few, if any, foresaw the extent to which city limits, within which service must be given, could be broadened, or the tremendous barrier that custom itself would interpose against any increase in the rate of fare.

I have no hesitation in saying that some of our electric railway construction was unwise—but this is hindsight and not foresight. Electricity was a new power that had clearly demonstrated its superiority over all other means of urban locomotion, and in-

vestors and speculators alike were carried off their feet. Many of these men were the pioneers who foresaw the need for some kind of transportation, and some of them were the real estate developers who knew that their lands were of little value unless they were connected with the business section by some means of public conveyance. Just how much actual value was added to the wealth of the country by the provision of these means of transportation no one can say; but it must be enormous. More than any other factor of which we have any knowledge has it aided in that centripetal movement for business and that centrifugal movement for residence which has characterized the late nineteenth and the present twentieth century. And remember that the electric street car stood unchallenged during all that period as the preëminent means of urban transportation. We look upon the automobile industry as one of phenomenal growth, but we too frequently lose sight of the fact that the growth and development of the electric street car were almost as phenomenal if less spectacular. Under these circumstances it is not surprising if mistakes of judgment should have been made.

REVOLUTION IN TRANSPORTATION

Moreover, no one could have foreseen at the opening of this century that a means would so soon be provided whereby every family in the United States could have a private conveyance of its own, simple to operate, speedy of motion, and economical in cost. But the fact is that in 1926 more than nineteen millions of passenger automobiles were registered in this country—an increase of almost 100 per cent over the number in 1921. To go back still further it is interesting to note that the passenger car registrations for the United States were four in 1895, eight thousand in 1900 and only a little more than a million and a half in 1914 at the outbreak of the European War. Is it too much to say that this represents the greatest, and most complete revolution in transportation that the world has ever known? And is it surprising that the common passenger carrier, the electric street car, should have its progress somewhat halted while this gigantic revolution was in progress?

But the private automobile has affected the common carrier in quite another way as well, for it has been the means of placing on our streets a mass of vehicles far and away beyond their capacity to handle, with the consequent clogging of all arteries both for public and private conveyances. Street car services have been slowed down, operating difficulties have been increased, and many a potential rider has been turned away from the public conveyances, either through finding that the street cars which the density of moving traffic will bear are inadequate, or because their progress is so constantly halted as to make riding in them unprofitable.

But the private motorist, too, has been affected in much the same way, and, leaving his automobile at home in disgust at the time he has to waste, he turns again to the public carrier and joins with those who demand that the service which provides for the many shall not be hampered by the selfish demands of the few. Thus out of evil good is at last emerging and I see in the near future a national recognition of the right of the public conveyances, with their scores of passengers, to proceed without hindrance from the multitudes of parked automobiles that frequently cut our surfaceways in half. Were all of our twenty million automobiles to *proceed* while they were upon our public highways—as the street cars do—we

could still take care of them, even though our streets, laid out generations ago, were not designed for any such traffic. But when they squat down in our streets for hours at a time, occupying on an average sixty square feet of street space, and ultimately emerge from the curb to carry away an average of less than two passengers, they are trespassing on the hospitality of the public that cannot afford such entertainment for them. I say without hesitation that the greatest detriment to the street car—to the form of modern urban transportation that is almost universal in our country—is the parked automobile, and that it is the public and not the street car companies alone that must awaken to the need of reform. I am a little afraid that many a citizen who has read the plea of the street car companies for this reform has interpreted it in the light of a selfish demand on their part, and has overlooked the great public interest that inheres in it. I say, further, that the place of the street car in the modern city depends considerably on the public recognition of this injustice—if it is corrected then public transportation can resume its rightful place; if it is neglected, it will be at the cost of the many in order that the few might be accommodated with something to which they have no moral right.

PEAK LOADS AND TRANSPORTATION

I have spoken of the concentration of business within our cities and of the spreading out of the residence areas. This has characterized our city development and is in line with the modern tendency of specialization and mass production. If a reversion to the village type of industry were thinkable we could not begin to produce the quantity of goods and services which our standard of living calls for except at the cost of the sacrifice of a great part of the leisure time which we now enjoy. Workers, in the main, gain their livelihood in one place and recreate and live in another, and the time involved in getting from one to the other is precious to them. They chafe at hindrances, and demand a means of going from one to the other, just when they are ready, with the consumption of the smallest amount of their leisure time and with the minimum of discomfort. There are few people who realize that almost half of our passenger traffic is carried in four hours out of the twenty-four—for the demands of specialized business are such that we must all, or nearly all, be at our benches and desks during precisely the same hours of the day, and available for that interchange of work that makes possible our intricate and complicated economic life. It is true that some studies are now being made of the possibility of "staggering" employment to relieve congestion, but so far little has been accomplished in this direction.

These "peak" loads are the bane of the transportation industry. They necessitate the provision of a great many cars held in readiness to serve when needed, the employment of an army of men to run them, and the availability of great sources of electric power far and away beyond the needs of the other hours of the day. All of this adds to the cost of transportation and must be figured in any of our estimates. In the modern factory, in order to cheapen production, an effort is made to have the machinery run smoothly and regularly and to avoid overtime charges and the costs of slackness; also, much has been done in productive industry to cut down the seasonal peaks and depressions in the interest of regularity of employment and cheapness of production. But in the urban transportation industry little can be done in this matter, for people

demand that adequate service be available just when they want it. The electric railways have, to the best of their ability, provided a "readiness to serve" —a factor which has been recognized as part of the cost in the electric light and gas industries but seldom in public transportation. When this is recognized there will be less difficulty in bringing up the rates of fare to a point where they will become compensatory and not confiscatory as many of them are at present.

INCREASED COSTS

The electric railway industry in America started off unfortunately when it adopted the nickel as the standard price for an indefinite ride. I will not go into the reasons for this franchise arrangement in the United States, nor do more in this connection than state that the policy in Europe has been almost universally that of the "zone" system. Suffice it to say that we have the indefinite ride system thoroughly implanted in our American cities, and until a very few years ago, the nickel represented the universal fare. All might have been well had the price level of commodities and services been maintained but the street railway industry soon found itself forced to buy with a depleted nickel and sell for the same original coin. In buying from competitive industries people had to pay more of the depleted nickels for whatever they wanted to obtain—everything except street car transportation where their minds were fixed on a five-cent fare. The battle for a reasonable increase was a long and difficult one and the field was strewn with the corpses of transportation companies that had gone under in the fray. But the communities soon realized that the death of their urban transportation agencies threatened the very life of their undustries and their own well being, and so, with no little reluctance, they permitted those increases which today, over the country as a whole, represent less than a 50 per cent increase over the 1913 rates, while wages in this industry have increased 127 per cent and construction costs over 100 per cent. In my opinion there is still urgent need of an upward revision of street car rates if merely to meet the increased cost of service.

Somehow or other there has grown up the idea, prevalent among many of our citizens, that transportation companies have an inexhaustible supply of funds from which they can draw. Perhaps it is because they see so many people on the cars and hear so many coins dropping into the fare boxes that they feel justified in concluding that the revenues are sufficient to maintain the system. But that this is not so is witnessed by the number of street railway companies that were forced into liquidation a few years ago, by the bonds defaulted, by the dividends passed, and by the number of financial reorganizations which wiped out hundreds of thousands of capital investment at a single stroke. But those matters affect the investor alone, or at least the car rider is not seriously disturbed by such happenings. He little realizes that the poor and ill-kept tracks which make his ride uncomfortable; the out of date cars which strike him as so much inferior to his own comfortable automobile; the slow pick-up electric motors that are as different from the modern ones as a 1927 airplane engine is from the original one that Wilbur Wright flew; and the tardy, intermittent service on the streets are all due to the fact that street car companies have no inexhaustible fountain of funds for maintenance, and that they are entirely dependent on the revenues that come in through the fare box. Such evils as these will only be corrected

when the public is willing to pay a reasonable fare—one which will defray the cost of the service, give a reasonable return on the investment, and attract the new capital necessary for extensions of the service and to keep up with the times. Local transportation must keep ahead of city development, not drag along behind it, and must continue in the rôle of pioneer that it has always filled. Granted a reasonable fare, freedom from unfair taxation and paving charges, the electric street car will be restored to its rightful place in the community.

Now let us turn to the question as to whether the electric street car has a right to survive. Is it the best known method for public transportation? This question brings us right back to the statement I made at the opening of this article—that there is no one method, not even the street car, that will fill every need and meet every situation. For cities like New York, with their towering skyscrapers and densely packed office and apartment house buildings, separate roadways for a large part of the passenger traffic are an absolute necessity. For this reason we have built subways and elevated lines, which operating on their own right of way, can render a service much more speedy than that of a street with mixed vehicular traffic. Other very large cities such as Philadelphia, Chicago and Boston in this country, and London, Paris and Berlin abroad have already realized the need for high speed services operating without any interference from other traffic. Quite a number of other cities in America, such as St. Louis, Detroit and Pittsburgh are now giving serious attention to this same subject. In none of these cities is there any idea that surface transportation can be eliminated, but the high speed lines will be supplementary to the surface lines which are of slower operation and designed for more frequent stops and shorter hauls. Any form of high speed transportation on private rights of way is necessarily very expensive, and only the very largest cities can afford this luxury. It would be ideal if all public transportation could be taken off the public streets but the cost of this in any city would be prohibitive.

THE MODERATE SIZED CITY

This brings us to the second group of cities, namely those of moderate size. For them, street transportation is their only choice, and I have yet to learn of any more efficient means of street transportation than the electric car. I say this in view of the fact that there has been much talk of the motor bus supplanting the electric car and because the idea was at one time prevalent that this newer form of transportation would soon completely take the place of the old. Up to the present time, no city of any size has found it expedient entirely to replace its street cars with buses. The experiment has been tried in several places, notably in Bridgeport, Conn., and Des Moines, Iowa, but only a brief trial was necessary to convince them that the street cars on rails were essential to the life of he city. It is true that there are many cities in which part of the service formerly supplied by electric cars is now being given by motor-buses, and where this is so, it is usually the street car company that has made the change and is rendering the service. For we, as an industry, quickly realized that the bus has a place as a feeder, or for auxiliary services, or for rendering complete service in small cities. The bus is gaining recognition and coming into its own in many communities in which, in the excess of zeal of rail building, tracks were laid down years ago. Our records show that the average size of

cities in which abandonments have taken place is 8,000, and the actual amount of mileage abandoned is only 4 per cent of the mileage operated at the peak of 1917. As a matter of fact, a much greater mileage has been added by the street car companies in the form of bus service, than was taken off by track abandonments. This is simply a recognition by experienced operating men of the fact that the bus has a definite place in the scheme of public transportation, but that that place is a subordinate one and not the whole transportation field. No one need fear that any means will be neglected by the men who have now, and have had for years, the burden of supplying urban transportation, or that any new means will be neglected, or any opportunity missed for cutting down costs or improving service. In fact, some of the rail abandonments that have been followed by bus service have been due to a desire to escape excessive taxation and foolish paving charges, and some of these, in turn, have been followed by the restoration of the rails on the urgent pleading of the communities affected.

SUMMARY

If these two contentions that I have made here are granted, first that every city of any size needs some form of public transportation, and second that the electric car on rails is the safest, cheapest, and most efficient means yet devised for mass transportation, we can then raise the question as to what are the conditions that should be granted to this industry in order that it might be able to function most effectively in the public interest.

First of all there is need of considerable franchise revision and the freeing of both communities and operating companies of many of the out-of-date provisions which they include. We must popularize what is known as the indeterminate franchise under service at cost provisions, so that the best efforts of the operating company may be put forward at all times in the certainty that their business will be a continuing one and not subject to the whims of politicians, and so that the public shall receive their transportation for no more and no less than it costs. Under this method service improvements are possible, the investment of capital is encouraged, and city development is enhanced through the ability of the company to lead and not follow in supplying transportation service. Under such a franchise Cleveland, as an example of a large city, has built up a splendid urban transportation service. These are some of the means which local communities can themselves adopt for the improvement of their local passenger service, and of course they can also be of great assistance in enforcing no parking ordinances and efficient traffic devices. They can help further in the matter of local tax assessments though it will frequently need state action to get a full measure of relief in this direction.

In conclusion, I wish to say a word for the need of unified and coördinated service for every city. We have long realized that competition is detrimental to service in the case of telephones, power, light, gas and water supply. It is equally true that competition is destructive in the transportation field, and, where regulation is effectively applied, there is no possible justification for it. The proponents of the competitive idea claim that competition keeps the services on their toes and anxious to give the best they have. This is true if keeping them on their toes means striving to get every cent possible at the minimum of expense but it frequently results in being down at the heels—the condition

of many a passenger carrier who has found that the cream of his business has been skimmed off by competitors who have waited till he has established a demand for service and then have come in to enjoy the fruits of his labor. Let me stress this fact again, that real and efficient service can only be provided where there is prosperity, and no carrier will feel justified in spending the enormous amount of money that is necessary to establish a well rounded city service unless he feels secure that his investment will not be wiped out by some competitor. When a steel rail, or a pipe line or a transmission wire is put in position it is there permanently and has no alternate use. Consequently the business cannot be taken up from one place and set up in another as can be done in most cases with manufacturing and commercial industries. If its patronage is destroyed then all it can sell for is junk. The city transportation industry is an essential service that produces the best results when it is all in the hands of one experienced management. Coördination and not competition, security and not fear, fair treatment and not oppression will supply the needed incentive to keep our public transportation agencies in the forefront as builders of cities.

Rapid Transit Development and the Modern City Plan

By J. Rowland Bibbins
Consulting Engineer, Washington, D. C.

TWO questions must be answered by the modern city builder: (1) Does rapid transit congest or decentralize? (2) Who will provide the funds for decongesting? The first question will be answered last.

The problem of City congestion resolves itself into quite independent factors:

First, capacity—to handle the necessary transport units at the right time through terminal throats, usually at the center.

Second, speed—sufficient to serve outlying districts in reasonable time, home-to-work. Here is a paradox—that *maximum* capacity occurs at impossibly *slow* speeds and vice versa (involving safe braking distance).

This paradox is the source of much confusion and bad planning today, theoretically desirable but practically defective because ignoring basic dynamic laws which every transportation man knows. We are trying to handle "local, express and freight" traffic on the same "tracks," *i.e.*, streets already cluttered by business, with "block signals" set for one *or* the other; they can be designed for securing *both* capacity *and* speed. This is the function of rapid transit.

The Perspective

A comprehensive transport system for large cities providing proper capacity (and differential speeds) involves:

1. Rapid transit, on separate rights of way, surface outside and elevated, depressed, or subway inside.
2. Street railways and local bus auxiliaries.
3. Railroad surburban service, steam or electric, preferably through-routed rather than dumping at central terminals.
4. Express motor coaches.
5. Automobiles and taxicabs (private transportation).
6. Motor trucks for freight distribution.
7. "Shanks mare" (about one-fourth of the workers walk to work).
8. Horse-drawn vehicles; must avoid central districts entirely.

A proper perspective of this transport picture coördinates them all into a city-wide, well-integrated system, with radial trunk lines for main movement and laterals for feeders and cross-town service. The technical and practical problem, a difficult one, is how best to adjust plant and capital investment for maximum use. This is practically a problem of the rush hours, when two to four times base day capacity must be provided. It is idle to talk of *supplanting* electric transport by buses or vice versa. Cities have not been suitably built and cannot be re-built now. Basically, speed and cost must and will control. The broad view of coördination then is the *right vehicle in the right place.* But the partisan view usually means displacing "the other fellow."

Use of Private Automobiles

Private automobiles are used today because they are needed to save time. Of course there is a limit popularly defined as "congestion," practically meas-

ured by the efficiency of the city plan and traffic control. Then the only recourse is consolidated transport in larger units; first, street cars and buses, finally rapid transit and railroads, taxicabs of very minor importance.

Total riding habit is increasing probably as the square of the population, and perhaps higher due to automobile rush-hour movement. But the effect of automobile use, competitive to a serious degree, has resulted in decreased riding habit on the street railways as for example in Detroit (no rapid transit), where it has dropped steadily since the war time and autos probably handle about one-third as much traffic as street cars. In Washington the rush-hour auto movement appears to be around one-half (one and one-half times all day), and in Indianapolis about equal. But the Chicago street car riding habit has mounted steadily upward, a testimonial to its high standard of transit development. With decreasing railway riding habit due to congestion and competition, railways would gradually disappear into the background, but a fair analysis of city transport and traffic today reveals conditions that point unmistakably to a turning point upward for the future, and that rails are still the back-bone of mass transport, the cheapest and most dependable.

SMALL AND LARGE CITIES SHOW SIMILARITY

The small city and the large city are much the same in characteristics, the former showing quite as great auto density and increasing rates of registration as the large. When street capacity (on the prevailing low standard of use efficiency) is exhausted, private transportation automatically gives way to rapid transit. Today our near-big cities hold the greatest opportunity for corrective designing along modern transport lines. The big centers have reached fixation which can only be cured by rapid transit at separate levels.

The 30-minute time zone controls major population distribution. The majority cannot and will not spend more time, home-to-work. This absolutely requires differential speeds, different facilities and in some cases differential fares. A saving of five minutes running time extends the 30-minute time zone on surface transit by about one mile radius. This increases the zone area fifty per cent available to outlying residents (area increasing as the square of the radius). In most large cities the density crest (population per square mile) is in the two- to three-mile zone, *i.e.*, short haul. But every minute saved becomes increasingly important outside of the crest zone. We have got to play for *minutes* in rapid transit today.

Our million class cities cover over 100 square miles (the "metropolitan district" 364 square miles, or nearly twice the city radius). In a round city this means 5¾ miles radius to the city limits. The 30-minute ride thus requires a schedule speed of 11½ miles per hour. Rapid transit local service at 16 miles per hour would reach but 8.2 miles with a 42 per cent longer ride in 30 minutes. Rapid transit express service 22 miles per hour would reach 11.2 miles, twice as far. Railroad surburban express service at 30 miles per hour would reach 15.3 m.p.h. radius, two and two-thirds times as far. Buses are little if any faster than street railways (9.5 m.p.h.) unless operated in small units with only few stops per mile, or large units with limited stops.

This is the real reason for automobile use today. They practically reach rapid transit express speeds. Moreover motors and buses are using streets costing $50,000 per mile as against rapid transit costing up to 15 millions or more per route mile. While mass

movement, mainly short haul, must be handled by street cars with bus auxiliaries and feeders, long haul traffic has only rapid transit, railroads, express buses or autos to fall back on. Unfortunately the auto habit is thoroughly ingrained in both short and long haul riders which can only be corrected by real rapid transit facilities.

CITIES DOUBLE IN POPULATION

Large cities double in population in 25 to 30 years (ranging 5 to 40 years). Meanwhile city passenger traffic, rail and rubber, increases about four times, city land values and tax revenue three or four times, railroad passenger traffic about eight times. And the cost of facilities increases much faster than the population growth, taken in the long run, because of the greater cost of terminal distributing facilities. These are mathematical laws based upon fact, not whim or assumption.

We must plan now for doubling transport facilities, street, rail and rubber within less than one generation. Who is to bear the cost? New York is approaching three-fourths of a billion in transit investment and the city budget is increasing as the cube of the population, with land tax values at a much less rate. The deficit must be provided from new sources or the inevitable penalty will be stunted growth and subnormal city life. That the problem cannot be avoided is indicated by the fact that office building cubage, reflecting the daily peak load is mathematically increasing, as the 1.4 to the 2.0 power of the population, depending upon the city.

Private capital has failed to meet the needs of this steady growth due to the enormous mounting investments, the high cost of money and subnormal return on investments at a reasonable fare. This appears to have reached its limit at about 10 cents, beyond which other means or private transportation is resorted to. Hence large cities have had to take over the burden of capital investment in rapid transit at lower fixed charges (city bond rates) and even to tax the people for a part of the fare as in New York where the taxpayer now pays for rapid transit half as much again as the car rider. With future facilities doubled, the city's investment must therefore assume the commanding position. Municipal ownership must come whether we like it or not.

But operation is another matter and in the future, cities should in my opinion develop along coördinated lines by equitable contracts with private operators for the combined operation of both public and private facilities, not along the lines of the hopelessly scrambled system of New York, which has now become so complicated as to suggest the necessity of swapping lines (between I. R. T. and B. M. T.). The over-burdened Boston system thus necessarily drifted to public trusteeship. Under our present political systems, caution and good sense dictate private operation by contract as far preferable, safer and less embarrassing to cities.

CITY STREET FACILITIES

City street facilities for mass transportation of today and tomorrow appear hopelessly incapable of supplying the necessary line and transport capacity. In Philadelphia nearly every down-town street is occupied by tracks, one-way because the streets are generally too narrow (50 feet) for two-way traffic. In Chicago a two-track elevated terminal loop is forced to handle traffic from 13 rapid transit tracks entering the Loop District, which fact alone justifies subways. Boston's meandering streets forced the development of "surface subways" or "subway dips" and the rush hour traffic pressure became so great that at the maximum hour 227 car units (cars and trailers) or

207 cars per hour were operated on a single track in the Park Street station, or 15.8 seconds headway between units. This could only be accomplished by multiple berthing and electric announcing system.

Surface car subways cannot be self supporting as a rule, as the line capacity is definitely limited by the type and loading speed of cars at stations. To equal Boston's capacity every station would have to be a Park Street station; out of the question. Furthermore high capacity means low speed, defeating the very purpose of rapid transit. But we must have surface subways even at the excessive cost, and they should be considered as a city substreet, in lieu of widening, the operating deficit to be adjusted equitably between various beneficiaries. Thus Philadelphia is planning a 30-million dollar subway dip under Chestnut Street. Chicago must have some dips, but high-speed normal rapid transit subways are far preferable and Detroit is planning entirely on this basis.

Elevated systems are not popular, though more healthful than subways, and can be designed fairly noiseless through a ballasted road-bed, and fairly attractive by concrete center post construction. They may have to be used for long suburban lines as the cost is but a fraction of subways, although in some cities, due to favorable subsoil the tunnel method is claimed to be preferable. But where suitable rights of way are available, the elevated system has great advantages.

Depressed rights of way are attractive, as in Brooklyn, and are comparatively noiseless, healthful and much less unsightly although costly in land. But this type is limited in application.

SUBWAYS FOR DENSE TRAFFIC

Subways are the inevitable choice for dense traffic, but tremendously costly, and unfortunately noisy and less healthful than transport in the open air. Philadelphia's Broad Street subway cost over $90,000,000 for six miles, or $15,000,000 per route mile, including central terminal. Few cities, especially round cities, can support such investments without very dense traffic, or a high fare, or possibly, supporting deficits out of taxation as in New York. Yet subways are the only real means of mass transport, at least through the center of congestion. No railroad in existence can operate 10-car trains at one and one-half minutes headway, with trains reaching a speed of 30 miles per hour before the last car leaves the station. Yet this capacity is demanded in rush hours in New York.

Rapid transit started in our large cities as follows: New York, 1870, 950,000 population; Brooklyn, 1885, 710,000 population; Chicago, 1893, 1,215,000 population; Boston, 1897, 810,000 (metropolitan district); Philadelphia, 1907, 1,450,000. Los Angeles and Detroit are both hesitant of the expense but history is an implacable despot. The modern transit system must transport every day an entire city's population once or more times and 20 per cent of the day's traffic during the rush. The utter impossibility of handling the normal traffic of our largest cities by surface transport, either by rail alone or much less by bus, is thus manifested.

The railroads will have to serve long haul suburbs with limited stops out to the city limits. Chicago North Shore is an example bringing 30 miles of shore line within reasonable commuting radius. These suburbans should be part of the rapid transit system. Monumental central terminals for the future must be abandoned for the "subway type" with lines preferably through routed for *distribution* instead of dumping traffic at the center. The Pennsylvania Terminal of New York was

cluttered by suburban traffic in its first year of operation. The Northwestern Terminal, Chicago, was standing trains three deep in its fifth year of operation. New York is already considering a complete system of suburban railway subways entailing 300 to 400 millions investment. But little actual progress has yet been made toward amalgamating these distinctive rapid transit services with city rapid transit as a joint facility, properly coördinated, and saving in the end vast sums of capital to each.

THE GREAT HIGHWAY PLAN[1]

The great highway plan deserves thoughtful consideration, developing strategic railroad rights of way for railroad and rapid transit uses with twin highways each side and grade separated crossings. The railroads have been too much out of the picture, yet their suburban services are part and parcel of city rapid transit. Detroit is developing a modification of this in the master highways, 204 feet wide, but not along railroads.

A well integrated system is thus imperative for the future regardless of ownership, city or company, with each type of carrier designed, operated, and scheduled to meet particular local characteristics. To develop such a system properly, complete origin destination surveys of traffic should be made every five or at least ten years. There is no other or better source of intelligent design and control. Reasonable operating contracts between the city and carriers for private operation will best accomplish this purpose as are now being worked out in Philadelphia for the Broad Street subway, and as are now under discussion in Chicago and New York.

[1] "Our Cities of Tomorrow." Monograph by J. R. Bibbins. *Automobile Trade Journal*, Anniversary Number, December, 1924.

Where is the capital coming from? With the example of New York before us, with tax values lagging far behind transportation investment, there appears only one practical and equitable resource for the future—benefit assessment—that is, a proportion of the cost of these facilities levied upon private property benefited by the improvements, somewhere in proportion to traffic destinations, modified of course by local conditions. The answer is simply arithmetic. The fare and income return is fixed and insufficient for the excessive investment. There is no justification in assessing all taxpayers for decapitalizing this excess investment to a normal return basis measured by the cost of money, while the true property owners benefit to the extent of two or three times their property value at the expense of the taxpayers. Thus benefit assessment is in reality subsidizing the early operating deficit and the amortization of present overbuilding because it cannot be helped.

Benefit assessment for traffic thoroughfare improvements may also very likely come about for the same reason. Chicago's great double-decked river road (Wacker Way) cost $30,000,000 a mile the same as King's Highway, London, but private property contributed over half in benefit assessment. Result: twenty-story modern office buildings have replaced the shacks of the old wholesale fruit district, an eyesore and menace to the community.

DOES RAPID TRANSIT CONGEST OR DECENTRALIZE?

Apparently it is a composite effect. First, congestion, later distribution, if through routing is adopted. New York has already paid the penalty of the centralizing phase in prohibitive land values, with higher and higher buildings, increasing mass cubage, resulting in an "economic spiral," which has now

reached a "ceiling" at about $25,000 land values per unit front foot. As this ceiling is approached in any city, business must "spill" outwards, as in the case of New York where it moved up town.

Meantime subcenters must be planned for the future. This phase is being neglected. Witness Wilson Avenue district, Chicago, formerly a deserted terminus of the Northwestern Elevated, now a young city. Chicago is waking up and building by-pass highways out in the lake by waste filling. But the old street system is past change.

ZONING

Zoning as an immediate aid in reducing congestion is of little or no effect but will be in the future. It cannot change the past. It is entirely too slow and the strictures on mass cubage and height limitations are too liberal and too little understood. From 25,000,000 to 30,000,000 live under zoning ordinances, but as yet the true economic height of buildings which should determine practical mass cubage and underlying land taxation have not to my knowledge been worked out. But we are completing such a determination in Detroit,[2] and the indications are that this mass cubage of the central mile zone will about double by 1950, and that the maximum *mass cubage height* will be below ten stories rather than above—certainly not twenty stories as enthusiastic constructors hold.

CONCLUSIONS

Our cities have been working too much in the dark and neglecting to study the underlying economic laws which will in the end control their destinies, despite all preconceived notions, political fetishes, oratorical displays, or even established property rights. Our main hope in providing speed transport for the masses is technical reëxamination, planning and coördination:

1. All public transport agencies integrated into an efficient system with differential speed (and fares) appropriate to character of service rendered.
2. Assessment of benefited property to finance at least the initial operating deficits and cost of temporary over-building.
3. Classification of traffic streets and facilities to develop maximum capacity and speed required, and paved accordingly, supported in part by a usage tax scientifically adjusted to such use and the wear and damage resulting.
4. Practical control and limitation of mass building cubage at the center through better understanding and application of economic principles, land values and taxation.
5. A transportation plan for the whole district to guide both city and corporate investments along intelligent and efficient lines at least cost-of-service, unified operation and service, regardless of ownership.

The time has arrived for the cities to assume more positive leadership in this technical problem of mass transport to prevent the further compromising of their destinies. We should plan *now* for at least double the present facilities. The need will develop all too soon.

[2] *Building Construction Forecast Detroit 1925–1950.* J. R. Bibbins, for the Detroit Edison Company. (Auspices of Dept. of Engineering Research. Univ. of Michigan.)

The Place of the Motor Truck in the Modern City Plan

By B. F. Fitch
President, Motor Terminals Company

CITIES as they exist today are the result of evolutionary rather than predetermined development. Growth and extensions have quickly followed improved transportation offerings, which alone make possible the expansion of community areas. As a result, many previously indispensable facilities are obsolete when compared with newer methods.

The original hamlets of this country were located on waterways. This was prompted by the then only available overseas, coastal, and inland transportation. With few notable exceptions all of our present cities represent their haphazard growth. The exceptions are: Indianapolis, Atlanta, Dallas, Denver and others, where the inception was prompted by available transportation, but rail instead of water.

Present Dilemmas

There is a remarkable similarity between all cities, regardless of their locations or industrial activities. As railroads were developed in competition with waterway traffic, the rails in every instance were projected to station points, as near as economically possible to waterway terminals. In reality the location of existing railroad terminals is primarily chargeable to the short-haul limitations of the horse-drawn vehicle, because merchants and manufacturers would have ignored competitive traffic appeals of railroads, if burdened with higher trucking cost to remotely located freight terminals.

It is deplorable that the previously indispensable old "Dobbin" should be responsible for our present city plan dilemmas, but such unquestionably is the case, because by reason of horse transportation costs, which soared out of all ratio, with increased lengths of haul, industry and residential growth were concentrated at the strategic center or hub of each city, with resulting disproportionate realty values and building activities, beyond traffic capabilities of the thoroughfares originally provided. The high cost of traffic congestion, both passenger and freight, is the big problem for solution by city plan authorities.

As time progressed, transportation offerings made possible an increase in the radius of city growth. In sequence, street congestion and economy demands developed massed transportation in the form of horse buses for convenience of those who could not own their private equipages. This was followed by the horse car, of greater passenger capacity, and the horse car in turn gave way to the trolley car. Then the elevated railway increased the radius, and the subway added to that, each in turn providing greater facilities for massed transportation, and resulting development of residential property further and further removed from the centers of vocational employment.

Contributions of the Automobile

These progressive steps in massed transportation proportionately relieved our thoroughfares of the burden of individual units of transportation, and thus progress was marked, regardless of city growth, with relief rather than increase of traffic congestion, until ad-

vent of the automobile. Regardless of its cost, time economy, personal independence, and convenience of such unit of transportation has so stimulated its adoption that now practically every family is mobile and resultingly elects its own residential site, being generally influenced by the desire to locate on cheaper realty as far as possible from the turmoil, confusion, and contaminated atmosphere of thickly populated districts.

The automobile has thus made conveniently possible area extensions of cities to a radius of fifty miles, and its investment and operating cost burden is justified by otherwise impossible appreciations in suburban property. In reality, through increasing the radius of workers' opportunities and through development of acreage into valuable city plots, the automobile has made its economic contributions to humanity. After justly passing this credit to the individually operated transportation unit, the debit account against it should be considered.

Vocational demands and transportation offerings result in the centralization at hub of an ever-increasing army of workers, which otherwise would never have developed. The effects in traffic congestion are apparent in towns of even 1000 population, and the high cost of this traffic congestion, with its remedy assessment on taxpayers, is the problem which has developed scientific thought on the subject of city planning.

Just how long any community can afford to permit every taxpayer to appropriate approximately 200 square feet of public thoroughfare any place his convenience elects is problematical. Economic demands have already developed in the form of motor buses, tendencies for repetition of the history, which recorded horse buses and omnibuses as massed transportation unit offerings to those who previously enjoyed the privilege of individually operated vehicles.

The difference is that operating radius of the motor bus as compared with the omnibus is as great as operating radius of the automobile as compared with the barouche, surrey or buggy, previously used. Hence, it is apparent that radii extensions of our cities are in the future assured, regardless of municipal unpreparedness or extensions of public service transportation.

City authorities can temporize with that subject as much as they want without affecting public decisions, because, individually or collectively, through use of the automobile or the motor bus, the public is, from a transportation standpoint, independent of municipal restrictions, except that of traffic regulations prompted by pyramiding congestion.

The greater the congestion the greater will be the dependence on massed motor bus transportation, extensions of which will tend to decrease congestion. So, the present traffic problem, apparently beyond remedy, except by municipal surgery at prohibitive public expense, will in reality solve itself, just as similar insurmountable difficulties of seventy-five years ago remedied themselves while city authorities were discussing ways and means at taxpayers' expense to accomplish the same result.

DECENTRALIZATION ESSENTIAL

Upon one point all traffic students and city plan engineers agree; namely, that decentralization is essential for the future health and prosperity of all cities. Through instrumentality of the automobile and the motor bus, irrespective of tardy extensions of public service transportation facilities, this problem is being solved and executed by individual investors, whose intelli-

gent capitalizing of a new facility is prompted by the business opportunity, not public convenience.

Where public convenience is concerned, industry is involved, and industry cannot largely expand or develop beyond the restrictions imposed upon it by railroads, since industry is dependent on transportation for existence. The freight station plants of common carriers, first inflexibly located when our present cities were but towns, with reference to densities of originating traffic and waterway competition, are largely responsible for congestion of our city thoroughfares. While originally they offered shippers short vehicle hauls to and from railroad stations, or team-tracks, the situation is now reversed, because, due to soaring realty values in the strategic center of cities where freight stations are located, industries have been driven into suburban districts.

The pioneers in these newer industrial developments enjoyed railroad siding facilities, but since the re-location of each of these previously centrally operated industries has developed specialized vocational talent in residential communities surrounding them, and further, since others in the same lines of business have been influenced to build plants in the communities wherein skilled labor was available, developments in each of these outlying districts of almost every city overflowed sites adjacent to railroads' rights-of-way, so that those who came later could not enjoy such strategic shipping advantages, and were dependent on vehicular hauls to freight stations of the common carriers.

From the above it is apparent that with increased population, city area increases follow, and city area increases result in longer vehicle hauls to railroad stations centrally located. The converging of vehicles from all points of the compass at these railroad stations for delivery of freight, and the radiation from stations of vehicles, which have collected their freight, all tend to a pyramiding of traffic at the strategic center or hub of the municipal wheel.

Now considering each city as a wheel the spokes of which represent railroads' rights-of-way, converging at the center, it is apparent that all shipments in freight cars brought to such center over rails for re-distribution by vehicle must be back-hauled over city streets under conditions where the average length of haul is constantly increasing with population and industrial increases. The reverse of this situation prevails with merchandise developed by industries and carted to stations for shipment. This existing back-haul of freight amounts to an economic waste.

The greater mileage capabilities of trucks over horse vehicles has been capitalized by investors in modern industries, through plant constructions further and further removed from the municipal hub on cheaper realty. Thus, the average length of vehicle haul to and from railroad freight stations increases out of ratio with population increases, by reason of the more remote location of newer industries made possible by the motor truck.

PROBLEM OF THE RAILROADS

During this progress in city growth, railroads have not limited their operations exclusively to the original centrally located freight stations. In the majority of cases the old buildings, remodeled and slightly extended, still function, because the same high realty values, which influenced industry to re-locate in the suburbs, have made impossible the enlargement of railroad terminal plants.

Logically, with industrial growth, larger stations were necessary to clear the pyramiding volumes of freight, but

since the centrally located plants could not be enlarged, except at prohibitive capital expense, supplementary or smaller stations were created in outlying districts on the rails of all contributing lines, as recommended by densities of originating traffic. These have been appropriately called "sub-stations," since they are supplementary to the main or centrally located station. Their numerical increase reflects both industrial zone developments and volumes of freight to be interchanged between commercial vehicles and freight cars.

While affording congestion relief both to shippers and carriers, the transportation problem of the railroads is thereby made more complex by reason of the plurality of station points within every city, developing merchandise lots for transport to the plurality of delivery stations in all other cities. So that the layman may appreciate this situation, it must be explained that the loading of five cars at one central station point for dispatch to five cities, with but one central station point each, is comparatively simple, because line-haul movement of but five cars is involved, but if five stations are each loading cars to five delivery points in the other five cities, the problem involves the line-haul movement of twenty-five cars.

Since so many of these "sub-station" points cannot develop sufficient quantities of freight to justify long line-haul movement of cars, it becomes necessary to consolidate the contents of these five cars into as few cars as possible at the point recommended by greatest convenience and economy of each railroad. This re-handling, when possible is at some one of the stations within the terminal area, otherwise at some intermediate transfer. From the above explanation it is apparent the increased plurality of car movements, each handicapped by its under-loading demands, has pyramided the transportation problems of the railroads into what at times becomes prohibitive expense, by reason of delays to cars in transit and labor cost of re-handling and resorting the contents thereof.

To effect these load consolidations, the carriers must resort to every ingenuity, and the intra-terminal movement of cars, variously termed "trap," "transfer," or "ferry," between stations, confiscates limited trackage rights of the railroads, indispensable to movement of both passenger and freight trains.

TRUCKING OF FREIGHT

After a trucking demonstration at Cincinnati, Ohio, and under the pressure of necessity, the carriers have been sub-letting to trucking contractors this intra-terminal or inter-station freight movement within cities, under tariffs too cheap for consideration when compared with carrying charges on capital expense otherwise necessary for increases in terminal plant. The freight handled by these contractors is trucked from the main or centrally located freight station to "sub-stations," and vice versa.

By this method, a one point make and break of less carload lots of freight is possible at all large cities, and in addition to the line-haul-transportation economy effected through maximum loadings of cars, and a resulting decrease in the number of cars employed, more prompt and flexible service is afforded shippers, inasmuch as freight so handled by truck is dispatched currently, whereas in the past, when loaded in "trap," "transfer," or "ferry" cars, it suffered a three- or four-day delay, and that time multiplied by the value of the merchandise represented just so much frozen capital of industry.

This intra-terminal trucking of freight by the carriers themselves, under contract with local cartage mediums, is fast superseding their previous intra-terminal use of freight rolling stock, in what amounted to no more than vehicular service. The tons so transported are insignificant as compared with tonnage increases of the old railroad plant, and being scientifically regulated in unit load movements, the tendency has been to decrease vehicular congestion, rather than increase it, because previously each individual shipper was performing the service, regardless of cost, with underloaded trucks returning empty, in order to expedite his shipments.

This service, first installed at Cincinnati, differs from others in that a plurality of containers as sorting bins is made available for each railroad, permitting direct interchanges between cars and containers, thereby eliminating in each movement one re-handling and re-checking expense. When loaded and sealed, such unit container lots of railroad freight are handled within two minutes between platforms and motor trucks by electric cranes for truck dispatch to designated stations.

Elsewhere the prevailing practice is to have vehicles parked at station platforms while hand-unloading and reloading of freight. That generally requires a minimum of one hour's time, at a pyramiding vehicular expense of five cents per minute, so that in reality, if the load amounts to four tons, the transportation cost is seventy-five cents, due to idle time before the transportation movement commences. In addition to this is the high cost of labor, re-handling freight from platforms to trucks and vice versa, with its attendant checking, etc., which amounts to an average cost of fifty cents per ton.

Of greater consideration, however, is that the average duration of trip time between stations at Cincinnati is but twenty minutes. This means that with container load interchanges at that point, one truck can be making three trips while a truck with rigid body is being unloaded and re-loaded. If you add to such the duration of trip time, it is apparent one truck does the work of four, and that means decreasing the number of such vehicles congesting the city streets by 75 per cent.

When describing passenger transportation, the subject was raised as to how long every taxpayer would be permitted to appropriate approximately 200 square feet of roadway area when and where desired. It is just as relevant to inquire how long any merchant or industrial plant can underload its freight vehicles and dispatch them for long-standing delays in hand-handling of contents. Such practice tends to largely increase the number of vehicles unnecessarily congesting city streets.

The weighted efficiency of all trucks, from a load and mileage standpoint, does not exceed 12½ per cent. This means eight times as many vehicles are utilized as would be necessary under an intensive coördinated program. If you add to such the time-factors as proven at Cincinnati of container load interchanges versus hand-unloading and hand-loading, it appears, mathematically, that thirty-two times as many vehicles are employed in freight service on city streets as necessary under a scientifically coördinated program, supplemented by universal and intensive use of the practice of container load interchanges.

ADVANTAGES OF TRUCKS

Just as massed transportation is relieving the passenger street traffic situation, so will massed transportation relieve the freight street traffic situation, as evidenced by the increasing

volume of packages handled by the American Railway Express Co., between congested centers and surrounding suburbs. But these progressive steps must be evolutionary rather than revolutionary, and they cannot precede the public's appreciation of its individual economy and convenience to be realized.

Motor trucks are creating opportunities for factory locations, with the same independence of conventional transportation facilities as automobiles and motor buses have emancipated the home investor from dependence upon public service facilities, and the result is an equalizing of realty values, with proportionate radial distribution of building activities, all tending to decentralize cities, with the single exception of this subject of inflexibly located main freight stations at the hub of the city wheel.

Where dwellings and offices are concerned, cities are growing vertically, but where commerce and industry are concerned, they are growing horizontally over a wider territory. Therefore, while demands for the terminal hub may exist, insofar as rail-passenger service is concerned, its duplication in freight facilities is becoming less and less essential and more and more of an investment and operating expense demand on railroads, because the major portion of the originating traffic is developed in the outskirts. Hence, why terminate the line-haul of railroad freight at the city hub for expensive back-haul to the outskirts, when more conveniently and economically it could be terminated in outlying districts for progressive truck-haul to the hub, thus relieving overburdened terminal rails for increases in passenger service, less otherwise unavoidable prodigious capital expense demands for additional terminal facilities, both passenger and freight.

CONCLUSION

Freight terminals so located should be connected by belt lines for interchanges between railroads, and thus nothing but the freight destined to the city, or originating at the city for railroad transportation, would become subject to truck handling by the railroads within the corporate city confines. Radial distributions by trucks from such outlying station plants would tend to distribute all existing centers of traffic densities. For small shipments of less-than-container, or truck lots, the railroads could operate on cheap realty a plurality of off-track stations as receiving and delivery offices, strategically located with reference to traffic densities, just as the American Railway Express Co. now does, or as the Baltimore & Ohio R. R. Co. has recently inaugurated in its terminal-passenger service at New York.

The plurality of these smaller stations, each serving its immediate zone, would in turn decrease the number of vehicles employed for cartage of smaller lots between merchants and off-track freight stations, and the assembly of freight lots at such stations into maximum unit truck-loads would decrease the number of vehicles cluttering up our public thoroughfares as previously outlined.

If you add to such the possible night movement of this freight between the proposed strategically located off-track stations and main stations, removed from the hub to the outskirts of every city, it is apparent that the big majority of merchandise vehicles now confiscating our streets will be eliminated, with proportionate increased capacity for passenger vehicles during the hours of commercial activity.

By the same token, coal, building material, and other commodity freight in volume deliveries can be trucked at

night, and many other abuses of daylight commercial operating privileges will gradually disappear, to the end that our existing streets can discharge their transportation obligations, less the high cost of surgical treatment proposed by so many city plan advocates to provide additional traffic arteries.

Under haphazard allocation to transportation demands the motor truck has already established its place in the Modern City Plan, but its ultimate potentialities under scientifically coordinated operation are as yet an unknown factor, because operators intensively concentrate on current demands, giving little concerted thought to future opportunities. Individual initiative will develop these massed freight transportation operations to relief of vehicular congestion, just as they are developing in the passenger field, because the economy inducement suffices to interest unlimited capital. Hence, in evolutionary manner the ultimate goal will be reached through individual initiative, and each step in that direction further influences realization of the Modern City Plan.

The Pedestrian and the City Plan

By J. Haslett Bell
American Society Landscape Architects, American Institute of City Planning

WITHIN the past twelve years city planning in the United States has made unparalleled strides forward. It has come from a little known science, in America, to a plainly recognized place in the sun of public opinion and public need.

City planning studies to date have been focused on the improvement of property, transportation, recreation and public health, but personal safety has received but little attention.

Personal safety means the full protection of the little human ant that has brought our civilization to a point where we have congestions and living conditions that force us into the consideration of this lately improved science of city planning.

A human being, whom we will now term a pedestrian, occupies but an average space of two hundred and forty (240) square inches when standing still, and can be crowded into a space of one hundred and eighty (180) square inches of floor space and less under forced conditions. This seems very small when one compares this area with the 9800 square inches occupied by a very popular small and low-priced automobile that is responsible for a considerable per cent of our daily roadway traffic.

The pedestrian moves at a normal pace of 3.2 miles per hour when unhindered, but this speed is reduced to 2.8 miles per hour in the sidewalk traffic of our down-town districts. The average automobile moves at a speed of twenty-five miles an hour on streets free of traffic congestion, and is slowed down to about ten miles an hour in dense traffic.

This comparison of bulk and speed gives the primary or basic reason for the vehicle being given the position of first consideration in street design and in street traffic studies to date. In park and recreational studies and in zoning the pedestrian has been a unit of more importance.

With our roadway and sidewalk traffic increasing to a point of danger to human life, and the daily increase of accidents involving the automobile and the pedestrian, we are being forced to think of a way to personal safety for pedestrians. With our police power that has to do with personal safety, health, and general welfare, and with a broadening public appreciation of the city planning as a personal help as well as a civic benefaction, we will soon determine and execute provisions for the needs of the pedestrian.

The Pedestrian and the Street System

In the outlying residential districts of our cities we find regions of single family homes. If conditions are ideal we find major traffic thoroughfares at eight average city blocks apart. In between these busy streets are the streets of lesser width whose sidewalks are rarely over four and one-half feet in width. So no pedestrian is crowded or endangered by moving vehicular traffic until he comes into the busy traffic arteries.

Even the more important streets far away from business centers are not so

intensely used as to require sidewalks of more than six feet in width, but as the congested centers are approached the need for additional sidewalk width is felt.

Several cities have made very close technical studies of roadway travel as compared with the movement on street sidewalks, but there does not seem to be any direct ratio or proportion between the two. So many factors, public and private, bear on the pedestrian traffic that no rule can be applied. The average fifty-foot residential street should have a roadway accommodating three lines of vehicles and generally uses a sidewalk of four and one-half (4½) feet in width. This sidewalk allows two people to pass one another comfortably.

As the street width increases and the improvements to property fronting it increase, so does the need come for wider sidewalks. In intensely built-up business districts, as are found in our cities of over 500,000 inhabitants, the demand for sidewalk width seems to have no limit. Existing streets use sidewalk widths based on a unit of two feet above the width of four and one-half-foot sidewalks used in residential sections.

50-foot street—sidewalks 4½ feet wide.
66-foot street—sidewalks 6–8–10 feet wide.
80-foot street—sidewalks 6–8–10–12 feet wide.
100-foot street—sidewalks 8–22 feet wide.

Means of Immediate Improvement of Pedestrian Traffic

Very few cities in the United States have a well-designed existing system of principal traffic thoroughfares, although many are making wonderful progress to that end. Until important streets have reached adequate width and are linked in a smooth working and adequate system, cities must make the best of existing facilities.

Present conditions can be very much improved for the regulation of pedestrian traffic by:

1. Making a few simple laws controlling pedestrian traffic in regions where such traffic has reached or is near a congested condition.
2. Erecting or installing equipment or street furnishings to aid in pedestrian traffic control.
3. Constant city-wide education in the existing pedestrian laws and in proper pedestrian conduct in congested areas.
4. Rigid enforcement of all laws governing the pedestrian.

Where there are no signal lights governing the movement of traffic at street intersections the pedestrian is generally forced to depend on his alertness for his safety. There is no reason why a pedestrian should not have the power to hold back vehicular traffic until his passage across the street is made. This traffic pause can be caused by an arm signal on the part of the pedestrian such as is used by traffic officers in halting traffic. The pedestrian can give it from the curb to approaching cars when there is a sufficient interval in the vehicular traffic flow. At least one city to date has granted such power to the pedestrian in rules governing street traffic.

Jay walking must be eliminated in the congested districts. Jay walking is one of the greatest causes of street accidents. It has been found that the rigid enforcement of regulations prohibiting jay walking has greatly increased the capacity of both the roadway and the sidewalk.

There is no traffic more difficult to control than pedestrians, but by rigid

and constant measures proper walking habits can be given to the public. Painted lines on the sidewalk and pavement are of great help. A painted line up the center of the sidewalk can serve to separate the two traffic movements. Lines at street intersections will outline the path of pedestrian traffic as well as forming a stop line for vehicular traffic. Mid-block crossings can also be marked by lines when needed and suggested by the constant crossing of pedestrians at important points. Raised sidewalks such as "The Rows" in Chester, England, would prevent jay walking or low metal fences at the curb, with openings at crossing points would help to regulate sidewalk traffic, and so increase the capacity of sidewalks and roadways through less interference to traffic movements.

Traffic signal lights, or traffic officers, or both will direct traffic movements at street intersections. It is highly important that vehicular traffic and pedestrian traffic be well synchronized. This can be made a public habit by periods of very rigid enforcement on the part of the police, backed by continuous attention to traffic law obeyance.

The "keep-to-the-right" rule should apply to pedestrians as well as to vehicles. During rush hours pedestrian traffic should be kept moving. Office buildings and department stores could very sensibly coöperate with the city by arranging lunch periods and working hours of the employees so as to avoid highly congested periods. Newspaper comments and advertising cards in street cars, in subway trains, and busses could suggest shopping hours between the daily rush hours. Selfish property owners or lessees often encroach upon sidewalk space so as to greatly hinder sidewalk traffic movement. Such practices should not be tolerated.

The Arcading of Streets

To bring relief to the congested thoroughfares in districts where land values are extremely high, one of the first methods considered in the widening of these principal streets is that of arcading the buildings to provide for sidewalk space, and to give the greater part of the former street width to roadway and vehicular use. This widening can be done through private or public effort, but mostly the latter.

One instance of private help in the arcading of a city street was in the building of the New York Telephone Company's new building. The building was arcaded on the Vesey Street side. This arcade is sixteen feet wide, nineteen feet high and two hundred and fifty-two feet long. The old curb was set back eight feet and the building set some three feet inside the new curb line. All parties concerned were helped. The building was given more foundation room and a wider roadway, and sidewalks were given to public use. Other fine examples in this method of providing wider streets and sidewalks are Rue de Rivoli, Paris; arcade through the Louvre Department Store at Palais Royal and Rue de Rivoli, Paris; Rue des Pyramides, Paris; Arlington Street at Piccadilly, London; "The Rows," Chester, England; with smaller examples in Zurich, Switzerland.

While we think of arcades that widen the street, there is another form of arcading that relieves sidewalk congestion, facilitates pedestrian movements, protects shoppers from weather, and furnishes splendid opportunity for shop display windows. This is the arcading through buildings or city blocks. Probably one of the best examples of this traffic innovation is in Milan, Italy, where a spacious, glass-covered arcade passes through a popular shopping block. Single buildings may be designed to provide such mid-

block ways because of economic advantages as well as a relief to thoroughfare traffic. This has been done in St. Louis and Atlanta.

While widening the streets without having to arcade buildings is the most desirable method in all cases, the coöperation of the owners of abutting property, where arcading is decided upon, can be a great help in making this method a successful one.

Subways as an Aid to Pedestrian Traffic

The traffic counts taken at various street intersections in large cities in this country and Europe show that a really appalling number of people pass a given point in a twelve-hour period. Including automobile passengers, street car passengers and pedestrians, these figures will range from 100,000 to 500,000 persons.

Subways as a means to carry pedestrians under these busy streets have many times been suggested. Such a method is a very fine safety precaution and aid to traffic movement. While several cities have a few such pedestrian subways either at street intersections or at mid-block, Los Angeles has plans for, and is going ahead with, about forty under-the-street passages. These subways are to be for the most part near schools to furnish the proper safe means of street crossing for school children.

There have been contemplated plans in other cities for various types of underground pedestrian thoroughfares. Paris, France, considered at one time a system of underground mechanical sidewalks moving at different speeds to accommodate local or through pedestrian traffic.

Overhead Pedestrian Street Crossings

Overhead street crossings for pedestrians would no doubt be much more preferred than subways. Pedestrian bridges would lend themselves to pleasing designs and have the benefits of light and air. Such structures would no doubt be much less expensive to construct than subways.

Mr. Harvey Corbett, an architect of New York, in a very well illustrated magazine article, has shown how present overcrowded streets in very large cities may gradually be relieved by working toward traffic accommodations on three levels. The traffic to be divided into three parts according to weight—heavy traffic of street transit and automobile trucks at one level, swift moving and lighter weight vehicular traffic on the second level, and pedestrians on the third and highest level. Perhaps the future may bring traffic relief through such a street program.

THE PEDESTRIAN AND TRANSIT

Transit is the local transportation of people within a metropolitan area either by bus, trackless trolley, surface street car, subway, or elevated lines. The system that includes these means of transportation should have lines that completely serve all residential, business, and industrial districts. The individual should not be forced to walk more than a quarter of a mile to reach the line in the outlying districts or the same distance to his work after alighting. Such service would help greatly in the lessening of crowded sidewalks and would no doubt lower the number of street accidents.

In the case of bus lines as a part of the transit system—the curb may be swerved or set back near the corners to provide a recess for a bus stop, apart from the moving traffic, and to bring this transit line to the street sidewalk, thereby increasing the safety to the pedestrian.

Where the pedestrian has to get on or alight from a street car in the roadway, some manner of protection must

be provided. This is done in many ways in different cities:

1. Safety zones, marked by removable standards often connected by ropes or chains. These standards are set up in the morning by traffic officers and removed at night.
2. Iron buttons set in the pavement to make a safety zone. The end buttons may be lighted at night.
3. Permanent posts sunk in the pavement. Lights or reflectors in or on the posts serve as warnings at night. These posts may or may not be connected by chains.
4. Raised platforms of either temporary or permanent construction, guarded at night by lights or reflectors.

Of these four methods of providing safety zones for transit line stations or stops, the permanent raised platform seems to be the best protection to the waiting passenger and provides a more secure island in the vehicular traffic.

While transit lines may be money makers to the operators it is to the city's advantage to see that fares are low. The price of fare has a great bearing on street traffic on the important thoroughfares. Certain recent times when transit lines of large cities have been for a time idle, or nearly so, have shown all too clearly why transit lines should be conducted so as to encourage their intense use.

Transfer points should be designed to furnish a maximum space for waiting passengers and a minimum distance between tracks for walking. In the case of subway and elevated lines direct entrances to buildings from the alighting platforms should be made possible.

In general the less distance the potential passenger of any transit unit has to walk the more are the public thoroughfares relieved.

THE PEDESTRIAN AND TRANSPORTATION

In this day of the increasing use of motor-driven vehicles the railroad has had to enter into the competition between bus lines as a matter of protection to its regional or metropolitan service. Many railroad companies have purchased busses to act as feeders to their commuting trains. The degree of thoroughness of such service has a bearing on vehicular and pedestrian traffic. If such service is good, many commuters will use it instead of driving their own automobiles into the dense traffic of the congested areas.

Local train and bus stations should be designed in regard to the number of people that may gather between service periods. These people should be provided adequate comfort and protection while awaiting busses or trains.

In larger stations the design of the building and the elements contained in it are worthy of careful study. Public waiting rooms should be large enough to accommodate the crowds that will use them, they should be well ventilated and have easy and very free access to surrounding streets and to the trains.

The lobby should furnish direct access of the pedestrian from the street to the trains. The access from the lobby to the waiting rooms, baggage counters, and cab platforms should also be easy. Where possible subway transit lines, elevated lines, surface lines and bus lines should be able to bring their passengers within the shelter of the railway station. The ease of access and of passage within the railway station is indeed helpful to street traffic, especially during times of unusual transportation use such as

holidays and the arrival or departure of celebrities.

Since the popularity of the automobile the public as well as the railroads have recognized the necessity of the elimination of grade crossings. There is no need whatsoever to point out the benefit of such elimination to street traffic and to public safety. The larger railway systems are yearly reducing the grade crossings on their lines. The greater part of this work has yet to be done and there should be no let up, but rather increased speed in the elimination of the major crossings that are now at the same grades. In the majority of cases the carrying of the street over the railway or the lowering of the railroad tracks seems to be the best method because of the economy of this method over the construction of subways, and because of the elimination of drainage problems and access of light and air. Street bridges or viaducts lend themselves to good design.

THE PEDESTRIAN AND PARKS

The term parks now seems to include all areas for out-of-doors recreational purposes. Recreation may be passive or active, and so involve areas as small as an open space or plaza within a group of buildings or a large preserve of thousands of acres of virgin country. Placing park areas according to size we have:

1. Plazas or open spaces.
2. Small parks made from odd parcels of land generally at street intersections.
3. Playgrounds.
4. Playfields.
5. Neighborhood parks.
6. Large city parks.
7. Woodland parks, forest preserves, or mountain parks.

Park areas have the necessary value of keeping us as strong and healthy pedestrians, else we might be affected by neglect of our physical welfare through the use of modern conveniences such as the automobile. All park areas should be as free and apart from the dangers of busy main thoroughfares as is possible.

1. Plazas and open spaces are generally thought of as formal. There the walks are on straight and severe lines and the use of architectural embellishment and sculptured figure relate the whole to the enclosing buildings. There provision should be made for the accommodation of crowds by broad walks and many seats as the scale permits or the use suggests.

2. Small parks generally found at street intersections can furnish a bit of restful green to an intensely built-up neighborhood. It furnishes the passer-by a place to rest and provides a fitting setting for a monument or fine piece of sculpture.

3 and 4. Playgrounds and playfields differ in purpose only in the age of the users. Playgrounds accommodate children below the teens, and playfields furnish larger spaces for the play and sport of larger girls and boys. Both should be well supervised and protected from surrounding streets.

5. Neighborhood parks furnish a chance for the people in a closely built-up nieghborhood to rest amid natural surroundings, to stretch their legs and to get a deep breath of fresh air. They cannot be large because of their location in regions of fairly high property values, but even areas of about twenty-five acres can furnish wholesome recreation to all the members of many families.

6. In the large parks there is opportunity to provide, much more, for the recreation and comfort of those that seek them. They should be of sufficient size to provide spacious views, vistas and meadows. Walks and

drives should be of length and with varied interest. All recreation possible in open and naturalistic country should be provided in these areas.

The first thought in the design of a large park is to make it a natural and out-of-doors area with all formal portions and buildings occupying minor and inconspicuous locations. Near the formal areas and the buildings accommodations for crowds and congestion will have to be made. The walk construction will be of hard and durable material. Walks and paths about the park, however, should be of such material as will not tire the walkers. Well-drained gravel or crushed stone is suited to this purpose.

Recreation space and facilities for all, from the small children to the aged, can be provided for in large parks. The larger the park the more inconspicuous will play areas become, and the less noise will affect the pleasure of those desiring quiet.

Walks and drives should have frequent and easy connection with the bounding streets. In a well-planned park system the linked parks and parkways make possible long bridle paths, park roads and paths. In Minneapolis long hikes are possible in the park system and leading to the wooded country outside the built-up regions. Walking and hiking should meet with every encouragement as an aid to public health.

7. Woodland parks and large areas of natural beauty near the city should be acquired in advance of growth. There the city dwellers may find relief from artificial surroundings in forests, meadows and along streams preserved for their use.

THE PEDESTRIAN AND ZONING

High buildings and intensely built-up property are causes of congested regions in our cities. Where masses of people work and live in comparatively small areas the streets are called upon to carry too heavy a burden of traffic. The conditions for health are bad.

With the power to restrict the height of buildings and the size of yards and courts, we are able to bring about conditions that reduce vehicular and pedestrian traffic. The decentralization caused by zoning is a very practical solution to the traffic problems of today, especially in those cities and parts of cities that are not as yet too far built up with high buildings.

The establishment of districts for use of property tends towards a permanency of building conditions that has its effect on traffic and kinds of traffic. For instance, if a residential district suitable for the small home of the factory worker is established within a short distance of the industrial district in which the man works, traffic habits and movements become constant and can be provided for with much more ease and certainty than with haphazard building. So zoning is a very effective means to better traffic conditions as well as to better the living and working conditions of our growing cities.

CIVIC ARCHITECTURE AND THE PEDESTRIAN

Even though, perhaps, we do not think of the pedestrian so readily in all of our civic and city planning problems, he is still the subconscious guide in all construction. Architectural design often departs from consideration of human beings, and this fact often shows in the appearance of the structure. There should be a direct proportion in all civic and public buildings to the height of the average man. Architectural details and composition as a whole should be designed with due regard to the way it will appear to the man on foot. Every building, every structure and every sculptured figure

should be provided with the setting it deserves. It is possible to construct walks and approaches so that the pedestrian gets the impression, on looking at the building, that the architect wishes. If details are too small to be clearly seen within a reasonable distance their cost has been to no purpose. And so it is with a massive structure in a squeezed location that makes the cost of its beauty seem a waste.

Even in so prosaic a thing as a city's street system, opportunity is often lost to take advantage of the locations that would so enhance the locality and the view to the pedestrian. Sites are often lost that would make possible fine vistas, or perspectives, and that would make business or residential districts extremely attractive.

The scale of a square or open space should be such as to accommodate the street and sidewalk traffic that may use it. The architectural detail and the height of the buildings should be designed considering the possible distance at which they may be seen by the pedestrian. Buildings, structures, and sculptured figures built or located in such a manner as to appear out of scale to the pedestrian are not an asset to the civic art of the city in which they are located. The scale and construction of all walks and roadways, and the scale of the planting around public or other fine buildings, should conform and also relate in texture to the buildings and the composition of the whole building scheme.

In all phases of city planning there is a direct relation to and a bearing of one part on the other. They interrelate so that an effect on one will affect another. In each phase the pedestrian is a unit that must be considered.

Regional Planning and Its Relation to the Traffic Problem

By Howard Strong

Director of the Regional Planning Federation of the Philadelphia Tri-State District

REGIONAL planning has come into being because cities refuse to recognize the limitations of their political boundaries. Planning for the future city means the planning of that whole area outlying the city proper, which is steadily becoming more and more an economic and social part of the central city, and which may or may not in the future have political identity with it. Any consideration of city problems, therefore, must include the problems of this metropolitan region.

Especially is this true of the traffic and transportation systems. Modern development of rapid transit, of means of communication, and the almost universal use of the automobile have been the principal cause in welding city and suburbs into an economic and social unit. Boundary lines have for most purposes disappeared. This interrelationship has in turn immensely complicated the traffic problem of the metropolitan area. There is endless going to and fro, from somewhere to somewhere else—the worker is separated from his employer, the buyer from the seller, the producer from the distributor and the consumer, the amuser from the amused—a multiplicity of contacts has arisen—all producing traffic on the streets and highways, and bringing highway engineers, police departments and the traveling public well nigh to desperation.

Approaching the Problem

A discussion of the problem has two distinct approaches. The first has to do with the regulation and control of traffic on existing streets and highways as they are. The second is concerned with the replanning of existing, and the planning of new thoroughfares to meet, with some degree of adequacy, the needs of the present and the future. The first is the effort to fit traffic to the streets and highways that we have, the second to provide highways which will meet the requirements of the traffic seeking a highway service, or, to paraphrase Morris Knowles, the first method is an effort to use more cunningly the tools which we have; the second, to supply new tools more perfectly to do the work which must be done. The first method is largely palliative, but is necessary to relieve conditions as they exist. The second is fundamental and essential for the future.

Fitting the traffic movement to existing highways should, of course, be regional in its scope. In fact, national and international standards and practices of traffic regulation must ultimately be developed. Regional planning, however, is concerned primarily with the second approach. Planning for the future, too, is concerned more directly with the outlying region than with the central city, for the city itself is largely crystallized in its street layout. Here and there a new street may be run through, or an existing one widened. But little replanning is possible. The region, on the other hand, is in considerable degree still in solution, its elements are in suspense and may still be crystallized in the form best adapted to future needs.

UNDERLYING CONSIDERATIONS

Certain considerations will be found to underly all regional traffic planning.

1. It is, of course, impossible completely to foresee future methods of human locomotion. It may be assumed, however, that we shall always travel on the ground, and in increasing volume for some time to come. J. Rowland Bibbins shows that as population doubles, traffic increases eight times. Since fundamental planning for the traffic of the future means the construction of new tools to meet this expanding demand, it follows that the soundest traffic planning is highway planning.

2. Highway planning must consider the whole circulation system, radial and circumferential, major and minor thoroughfares, through highways and local service streets, and must not follow simply the process of blood letting at congested points, which is characteristic of much highway surgery at present. But more than that, the whole economic and social structure of the region is inextricably bound up with the highway system and is profoundly affected by it. Thomas Adams points to the fact that the essence of value is accessibility. The utility of any area or of any building depends principally upon the extent of the availability of itself or its products. The planning of a circulation system, then, is an essential element in, and in turn, is determined by the planning of all those other physical factors which enter into the life of a people. Thus, highway planning, in its completeness, becomes regional planning.

3. The larger cities are today showing a definite tendency toward decentralization. The metropolitan population outside the political boundaries of the thirty-two largest cities of the nation is growing faster than that within the cities. The satellite cities of Philadelphia were, in 1920, growing 50 per cent faster than the city itself and are undoubtedly increasing the ratio. The Chicago Regional Planning Association reports a three to one ratio for its area. New transportation and power transmission methods have made this possible, and present-day and coming inventions—the telephone, the radio, the moving picture, the television—all stimulate the movement. Industry is partaking of this trend and merchandising follows population and industry. This movement is a wholesome one, bringing worker and industry, buyer and seller, and other elements of the community closer together and carrying other advantages in its train. Whether or not it is a permanent tendency, no one can say. Wise, far-sighted planning, however, can definitely stimulate it, and unwise planning can immeasurably delay it. In providing the circulation system of the future, then, every available means must be used to foresee future trends of population, new centers of industry, merchandising and residence. The failure to anticipate and provide for such development has frequently resulted in congestion of outlying centers which sometimes rivals that of the central city.

4. A new control of population distribution has appeared during the last ten years in the form of zoning. The allocation of industry, merchandising, single and multiple residence, and the limitation of population in a given district through the control of building height and area, such as zoning provides, are indispensable to an intelligent understanding of future demands upon the highway system. Without such regulation, factories are likely to find themselves served by narrow streets of light construction, planned for an entirely different purpose; stores

will adjoin highways without parking space for customers; residences will front on thoroughfares unnecessarily wide and of heavy construction, attracting traffic which does not belong there and which may be a nuisance to the neighborhood. The regulation of land occupancy through the control of the height and area of buildings makes possible the establishment of a relationship between the capacity of a street and the traffic population which it must ultimately serve. A designation of the future function of various districts is essential in fitting highway facilities to future demands.

5. Other probable uses of land not directly affected by zoning regulation must be anticipated if the various elements of the highway system are to serve, in location and character, the requirements of a well organized region. The creation of parks, regional and local, through which boulevards may run; the location of ball fields, stadia, recreation fields, and resorts which create occasional high peak loads, must be taken into account. Agricultural areas must have quick and satisfactory access to markets. Evidently as complete an understanding of future uses of land as is possible, is an essential in highway planning. Such an understanding is available only through a comprehensive study and planning of all the elements of the region concerned.

6. The highway system must, of course, be correlated with the other transportation elements. The increasing use of the truck for short haul freight, as a feeder to rail lines and for delivery to and from industries without railroad trackage or water frontage, requires a close correlation between highways and railway freight houses and waterway terminals. Buses as feeders to and extensions of passenger lines necessitate a similar relationship to passenger terminals. Bus lines as permanent substitutes for short haul railway and traction line service are still problematical, but must be reckoned with. City and regional planners are giving constantly greater attention to air fields. These will probably be outside the central city for some time to come and will demand increasing highway access. The highway system is clearly an integral part of the general circulation system and it must be planned in relation to these other elements.

7. While not a determining factor in their location or construction, highways must be planned as carriers of various public utilities, either above, on, or under the ground—water, sewer, and gas pipes, telephone, telegraph, electric light and power lines, and street railway and traction wires and trackage. These services require definite consideration.

8. Another element frequently receives too little consideration. Utility sometimes crowds out entirely the factor of beauty in the highway. As J. Horace McFarland says, "Is it to be a new white gash of concrete, treeless, but pole-bordered, straight at all hazards, and denatured of any suspicion of beauty in itself or of any possibility of beauty of prospect, or shall the road reflect what God planted in that Garden of Eden which is nearly all of America?" Certainly beauty has a claim upon the planning of that thoroughfare which has come to be so large an element in the recreation of the people.

A consideration of the above elements seems to indicate that any regional highway system will be incomplete and utterly inadequate unless it be a part of a complete plan involving every phase of all the physical elements of the region.

CHARACTERISTICS OF A PROPERLY PLANNED SYSTEM

Having in mind, then, these underlying factors, what will be the characteristics of a properly planned regional highway system? Some of the most important may be outlined as follows:

1. Obviously the system will be adjusted so as naturally to attract traffic to the particular highway where it best serves its own and the economic and social purposes of the community.

The street systems of most cities are fan-shaped in such fashion as to funnel most of the traffic into the congested center. This is due, of course, to the fact that business in former days was principally between the outlying towns and the central city with little provision for intercourse between the outlying centers. The radial system has persisted and circuit routes around the central city are still incomplete. As a result through traffic, not concerned with and not wanted in the central city, crowds its way through down town congestion to its own and the city's disadvantage. It is essential, of course, that radial routes giving free intercourse between the center and its satellites shall be provided. Easily distinguishable and direct by-pass routes, however, should tempt the through traveler around congestion centers, thus speeding him on his way and relieving city streets of an unnecessary and expensive burden.

Comprehensive planning of all physical elements in the development of the region makes possible the separation of local and through traffic. Subdivisions may be planned with curves and by-passes to discourage the use of interior streets for any but local and service uses, shunting general traffic into the bordering main thoroughfares. A remarkable instance of such planning is to be found in Merion Station, Pennsylvania.

2. Further classification of traffic in accordance with type of construction best suited to it will become possible.

Comprehensive zoning makes possible a nice adjustment of the type of road construction to local needs. Areas designated for industry may be provided with wide thoroughfares of heavy surface construction, having long turning radii and direct routing. Roads serving mercantile areas may be of lighter construction with provisions for parking for customers' cars and direct access to designated residence districts. Service highways within subdivisions may be of light construction with comparatively small area devoted to paving, but with the excess area landscaped and planted and ready for expansion should the demand arise.

Through highways will be so built as to encourage their use by traffic adapted to them. Commercial trucking and industrial highways will, of course, be as direct as possible, at low grade, with long radius curves and heavy construction and convenient to the termini and business area which they seek to serve. Scenic highways for passenger service need not avoid steep grades or curves, which add to the beauty and picturesque character of the route. Their surfaces will be adapted to this class of traffic and such highways may make detours through national and local parks and historic shrines if such points are planned or developed in advance.

Classification by legislative control is entirely possible in the future and the development of private rights-of-way for trucking routes and motor speedways is a factor

which must be considered in the general plan.

3. Manifestly, highways will be planned with reference to peak rather than average loads.

Such planning observes the "ready to serve equipment" principle accepted by all public utilities. Many street and highway systems which are adapted to the demands of average traffic find themselves hopelessly congested during daily or seasonal peak periods with enormous resulting cost and danger. Traffic regulation, through staggering of work and delivery hours, and other devices, can be of material aid in ironing out peaks and distributing the load, but the original construction will provide for this variation in demand.

4. All highways will of course be planned for ultimate future as well as present needs.

Here again, zoning proves invaluable. The limitation of use, bulk, and occupancy of buildings makes possible the construction of highways in proportion to the ultimate maximum use and load of the land. Such proportions have been worked out with a degree of accuracy and are available to street and highway engineers. Before the maximum use of land has been attained, adequate right-of-way should be assured and only such portion may be occupied by paving as the present requires, the remainder being left for the use of adjoining property for vehicle parking, or it may be planted with grass, trees, and shrubbery. Many states and smaller civil divisions have adopted standard width for ultimate development. Pennsylvania has designated 120 feet for all main thoroughfares; some towns in Michigan specify 120 feet as standard width for two intersecting main thoroughfares, while the Detroit Metropolitan Area has provided the following specifications:

	Feet
Super-highways	204
Mile section line roads and interior thoroughfares	120
Quarter section roads and secondary streets	86
Residence streets	60

No plans or subdivisions are accepted unless they conform to this schedule. Pennsylvania is unique and peculiarly fortunate in that its law, which has been frequently supported by Supreme Court decision, provides for the platting of highways and the protection of this platted area against encroachment until the construction of the highway, no matter how far distant in the future.

5. Certain general factors will find consideration in the planning of all through highways.

Such highways should follow the policy of by-passing centers of population with spurs to principal centers to serve local traffic. The du Pont Highway in the state of Delaware, running mile after mile, straight as a die through virgin territory, avoiding all populous areas but connected with these areas by well paved spurs, is a splendid example.

Grade separations for intersecting main thoroughfares may become ultimate general practice. The grade intersection is the prolific cause of delay and accidents, and, with the growing number of vehicles and their increasing speed, will, though expensive, be a sound investment in time and safety.

Great advantage is gained through the location of through routes in virgin territory. Since access is the principal element in land value, the location of a highway through terri-

tory unserved by main thoroughfares is usually less expensive and conducive of more direct routing than the utilization and connection of existing routes through built-up centers, which must be widened and improved at large expense. Frequently right-of-way through such virgin territory is gladly dedicated by owners because of the increased value to adjoining property created by such access. Such dedication has been common in the Tri-State Highway around Chicago, in the Sheridan Road and its connections from Buffalo, and in the Lee Highway and other trans-continental trunk lines. In states where excess condemnation and assessment of benefits on adjacent property are constitutionally permitted, the payment of the entire cost of the highway through the creation of "access values" is entirely possible.

6. Finally all highway planning will take into account the human factor.

Traffic may be conceived as following many of the laws governing other fluids—like water it follows the path of least resistance. Traffic will take the down grade of time; it belies Euclid's axiom that a straight line is the shortest distance between two points, for it has discovered that three untrammelled sides of a square are shorter than the fourth congested side. Police regulation and forced direction of traffic may serve to bring some semblance of order out of present confusion. But properly planned highways will induce a natural flow of this fluid into channels best fitted to serve it. The better the planning of the traffic conduits, the less the need for arbitrary regulation and police control. Traffic will thus become largely self-regulating and will contribute much to the joy and contentment of future generations.

SUMMARY

To summarize:

The city must be considered as including, for purposes of practical study, that great outlying region, which is becoming increasingly an economic and social unit with it.

The study of the traffic problem has two aspects:

(a) An attempt to adapt traffic to existing highways.

(b) The planning of a highway system adequate to meet present and future traffic demands.

Traffic planning for the region is primarily planning for future demands and is to be interpreted not in terms of regulation of traffic flow but in terms of highway planning.

Highway planning is effective only as it includes every element of the street and highway system.

Highway planning is effective and serviceable only as it includes or is included in the planning of every physical element of the region.

Highway planning must have intimate knowledge of population movements, and must take into consideration, and seek favorably to influence, the tendency toward decentralization in the great metropolitan areas.

Successful highway planning is dependent upon comprehensive zoning.

Future highways must be determined largely by probable future uses of land.

The highway system must be correlated with the other elements of the general circulation system.

Highway construction must give consideration to the various public utility lines and services for which it is the channel.

Highway construction must recognize the legitimate demand of beauty.

Based on the above underlying factors, the following elements of highway planning are suggested:

The highway system will be so adjusted as to attract to each highway that traffic which it is intended to serve.

Highway traffic will be classified in accordance with the type of construction best suited to its needs.

Highways will be planned with reference to peak loads, but regulation will seek to reduce those peaks.

Highways will be planned for future needs and made flexible in order that they may expand to meet those needs.

Through highways will by-pass population centers, will adopt the principle of grade separation at intersections, and when practical will seek right-of-way through virgin territory in advance of the need.

Highway planning will take account of the human factor and its tendency to follow the path of least resistance, thus substituting self-regulation for traffic direction and control.

Zoning and Its Relation to Traffic Congestion

By Ernest P. Goodrich
Consulting Engineer

THE Standard State Zoning Enabling Act prepared by the Advisory Committee on Zoning appointed by Secretary Hoover reads as follows:

For the purpose of promoting health, safety, morals, or the general welfare of the community, the legislative body of cities and incorporated villages is hereby empowered to regulate and restrict the height, number of stories and size of buildings and other structures, the percentage of lot that may be occupied, the size of yards, courts and other open spaces, the density of population, and the location and use of buildings, structures and land for trade, industry, residence or other purposes.

An exercise of this grant of power by any legislative body can only work in the direction of preventing traffic congestion if exercised in time and to a sufficient extent. Traffic congestion has been shown by experience to be detrimental to health, safety, and the general welfare, and doubtless incidentally also to morals.

Research has disclosed an intimate relationship between building use and bulk, and street traffic. Office buildings, loft buildings, department stores, theatres and apartment houses obviously may be said to create vehicular and pedestrian street traffic, each to a different degree and of a different kind.[1]

Comparisons of Street Traffic

Comparisons of the street traffic originating in different sections of two New England cities showed a variation which corresponded roughly with the known economic status of each section as determined by the average rent paid in it as ascertained by the Telephone Company surveys.

Obviously the total originating traffic includes not alone that from the owned automobiles, but also the deliveries made within each section of commodities consumed in it. Data collected for New York City by the New York, New Jersey Port and Harbor Development Commission, published in 1920, disclose 0.93 tons per capita per annum of foodstuffs locally consumed, 0.58 tons of building materials used up, 4.97 tons of fuel and 1.00 tons of miscellaneous commodities. These quantities vary to some extent with the economic status of the consumer and the rate of development of his neighborhood. In an average section it is estimated that the annual per capita consumption of all commodities would average 4.5 tons. The average load per vehicle reaching and leaving New York City freight stations was found by the same investigators to be 1.42 tons for 1772 trucks. The loads of vehicles used for local delivery will be less than this figure. Based on these figures it may be roughly estimated that the traffic to and from any residence section of a city would be approximately 0.2 vehicles per family per day for local delivery.

If each owned automobile leaves its owner's residence and returns to it (thus making a round trip) each day, the average number of such vehicles per family per day, which would be counted on the streets, would be twice

[1] See *The Influence of Zoning on High Buildings and Street Traffic* by Ernest P. Goodrich, Consultant on Traffic, Plan of New York and Its Environs, presented to the International City and Regional Planning Conference, New York City, April 1925, in *Planning Problems of Town, City and Region*, p. 459.

the average automobile registration per family. The total traffic would be 0.2 more—this being the figure for the vehicles making local deliveries per family per day as computed above. In one New England city, the registration per family was found to be 0.44. Doubling this and adding 0.2 would give 1.08. Traffic tallies on a large number of thoroughfares in districts which could be segregated so that the contributary families could be counted, showed an average of 0.98 vehicles per family per day of fourteen hours in the tributary territory. The difference between these two figures is well within the possible errors involved in the estimated population groups.

These estimates of traffic reduced to a per-family basis appear to govern the traffic which is incident to all types of residence districts—single family, two family and multi-family. Based on these studies it is obvious that the zoning of residental districts in territory for which the street plan has already been constructed should see to it that the density of families which is permitted at any point will not be such as to create more traffic during the congested hour under future motor use than the thoroughfare system can accommodate.

LOCAL BUSINESS AND INDUSTRIAL ZONES

The problem as to the outlying business district is well illustrated by the Saturday night traffic in the downtown district of a typical New England town. There is a business frontage of 2320 feet. Automobile patrons of the various business establishments numbered 584 during the three hours from 7 to 10 P. M. This is equivalent to 0.25 vehicle per running foot of business property. During the remainder of the day the traffic was nominal in comparison. In a large city in the middle west it was found that 120 feet of local business frontage created an average of 24 vehicles per day between it and the wholesale and industrial districts. This is at the rate of 0.2 of a vehicle per day per front foot of local business. On the basis of these and other pertinent data it is to be expected that each foot of local business frontage would correspond with about one vehicle per day in any traffic tally. In almost all local business districts it is the custom to use the stories above the ground for residence purposes. The resulting effect upon the street traffic will obviously be cumulative.

Closely akin to the type of traffic problem presented by the local business district is that of the industrial zones. Several new factors enter the problem at this point. The typical factory has as much tonnage entering as leaving. Crude materials come in by boat where the factory has a waterfront location. They come in by railroad car if the factory has a rail siding. They may come in by pipe line in the case of oil refineries or artificial ice plants. They may come in by vehicle over the streets and roads, and the introduction and improvement of the motor truck is tending to a greater and greater use of that means of conveyance. The same means are employed for distributing the manufacturer's product as for bringing in the crude materials.

Average figures show the following averages of tons of incoming raw material and outgoing manufactured articles per wage earner per year:

Year	Average Tons per Wage Earner In and Out of All Factories
1914	31.2
1919	41.2
1921	69.5

The increase in the tons per employe is obviously due to the growing introduction of machinery, which was especially marked during the war and is reflected in the great increase in the figure for the year 1921. As to any given factory or industrial zone, there will be considerable variation from this average, depending upon the specific commodity handled. Again, the highway traffic will be further affected by the proportion which moves by water, rail and pipe line respectively. For each zoning study these factors must be ascertained or assumed. In order to estimate such traffic, two additional factors are required—the average load per vehicle and the land area per employe. Certain data have already been given as to the average load per vehicle at New York City freight stations, *viz.*, 1.42 tons per load. A report upon the Boston freight terminals gives a figure of 1.13 tons average per load. The California state highway traffic survey of 1923 disclosed 2.1 tons per load. Little information is available as to the land area or the building area or bulk per employe in industry. The number of cubic feet required under certain state industrial codes is known and indicates a minimum figure. Original investigations in several cities as to types of industry, of industrial units and of the whole industrial section of the community have disclosed widely varying conditions. In connection with the formulation of a report in 1912 on *The Development of Public Docks and Shipping Facilities* in Newark, N. J., a personal inspection was made of fifty industrial plants of a wide range of size and commodity manufactured. These plants employed approximately 10,000 workers and occupied almost 1000 acres of land. The employes ranged from 4 to nearly 4000 per establishment, while the average land area per employe varied from 400 square feet to nearly 20,000, with a general average of 4000 square feet. In Elizabeth, N. J., a careful estimate (excluding all vacant meadow areas owned by plants but not used) gave 1500 square feet of land per worker. At the Bush Terminal this figure falls to 80. Were the buildings but a single story in height (as was largely the case in Newark) instead of the five stories actually existing in large part at the Bush Terminal, the Newark minimum of 400 would be obtained. Assuming 70 tons average per employe per year and 1.5 tons per load for both raw materials in and manufactured products out (and that the two are equal) it is found that each worker would correspond with 94 loads per year or 0.33 of a load per day (at 288 working days per year). To convert this figure to an area basis, the land area figures already given per employe are to be divided by 0.33 to give the land area which will correspond with one vehicle per day. The following table gives the data thus computed and also the results of certain investigations made in Cincinnati.

If the minimum volume of air space per employe permitted by good labor law regulation is assumed (400 cu. ft.), and the height and other restrictions are applied as exacted in the New York Zoning Ordinance, it will be found that 16.5 square feet of land would theoretically produce traffic equal to one vehicle per day. On the basis of a lot depth of 100 feet (as is common in New York City) six vehicles would be indicated per foot of frontage. All these figures must be adjusted to take account of all tonnage which moves by water, rail or otherwise than by vehicle.

To the commercial vehicles which daily visit any industrial section must be added all passenger conveyances which bring workers, clerks, officials

TABLE I

Type of Industrial District	Land Area per Employe	Land Area per Load per Day Based on Average Commodity Figure	Land Area per Load per Day Based on Observed Traffic	Estimated Vehicle per Foot of Frontage With Proper Lot Depth
Light manufacturing in loft buildings	.....	.....	200 (Cincinnati)	0.50
Ditto	80 (Bush Terminal)	240	.....	0.41
Medium manufacturing in plants	.....	.....	850 (Cincinnati)	0.18
Ditto	400 (Newark, min.)	1,200	.....	0.13
Heavy manufacturing in plants	.....	.....	1,700 (Cincinnati)	0.12
General averages	1,500 (Elizabeth)	4,500	.....	0.04
General averages	4,000 (Newark)	12,000	.....	0.02

and visitors. Observations at many industrial plants in outlying parts of the large cities have disclosed a worker's automobile parked all day for an average of ten employes. This figure does not apply to the usual type of loft building which is found in the centers of the large cities, or to the factories in towns which are so small that practically all employes can walk to their work.

From the statistics of manufactures it is found that the average salary paid in the United States is only about 50 per cent higher than the average wage paid. The latter was about $1200 during 1919. Salaried employes and wage earners can, therefore, be grouped together. Since, also, the total number of proprietors and firm members was only 2.5 per cent of the total of all those engaged in manufacture, it is evident that if all the proprietors visited their plants daily by automobile and 10 per cent of the others came in cars also, there would be an increase in the ratio of 12.25 to 9.75 compared with the figures which would apply, did none of the proprietors travel by automobile.

It is to be noted, however, that in the case of the average loft building the figures would be very different. On the basis of all loft building industrial proprietors using cars daily and no loft building workers doing so in one case, and all proprietors and 10 per cent of the workers using cars daily in another case, when the area per worker rises to 4000 square feet of land (as in Newark) while the lot depth increases from 100 to 200 feet, the frontage, per floor, equal to one vehicle per day changes from 784 to 80 respectively. In other words, the passenger vehicle traffic will be only one-tenth as much in the industrial centers of the large cities as in outlying industrial plant sections; that is, one-tenth as much per floor or practically the same as for a ten-story loft building. Adding these figures for passenger and for freight vehicles in the proper manner gives a range of frontage per vehicle per day from 2 in the loft building district to 30 in the outlying areas. Some careful computations based on observations in that part of New York City between Twenty-third and Forty-second Streets in the borough of Manhattan, where loft buildings are numerous, give a value of 4.3 feet of frontage per vehicle per day. The buildings within that area have an average height of 5.5 stories. Reducing the frontage in the ratio of this height to that of the specific

Cincinnati buildings to which those data apply gives 2.65, which is a surprising check on the figure 2 reached above, considering the differences in the cities.

Data secured for the amount of automobile traffic visiting a large New York department store gave one vehicle per day (as it would be counted on the street) for each 165 square feet of floor space or each 2.0 feet of frontage per story of height. In the New England town already described, one vehicle was counted on Saturday night for each 2.5 feet of frontage.

Counts made at several theatres, at the Metropolitan Opera House, and at several of the big football games show almost exactly one-tenth as many cars bringing patrons as the total capacity of each attraction. In the case of the football game, practically all cars were parked near the amphitheatre, while as to the theatres and opera house the cars were required to move some distance to park or to garage. The traffic would, therefore, be twice the number of cars in the first instance and four times in the second case. The total seating capacity of the theatres in the theatre zone in Manhattan in New York City is 95,294, and the street frontage is 9,400 feet. On the basis of one vehicle stopping at the theatre for each 10 seats there would be an equivalent of one vehicle per running foot of frontage, or four vehicles using the streets per running foot of theatre frontage.

RAILROAD AND FREIGHT STATION TRAFFIC

Railroad passenger stations are concentrated originators of vehicular traffic. Certain investigations made in a number of cities in New England and the middle west showed that about 10 per cent of those who visited the stations arrived or left in vehicles. Since each vehicle was counted twice, it may be figured that the street traffic was equal to 20 per cent of the number of persons who visited the station daily. This does not take into account the fact that the average vehicle carried 1.2 persons. Adjusting the 20 per cent by this ratio gives 17 per cent as the number which would measure the street traffic near a station. Such traffic is always denser near times of arrival and departure of trains, which fact materially affects street traffic density. Counts show that an equivalent of almost exactly 10 per cent of the population of each of several cities visited the railroad stations daily. These figures afford a basis upon which street traffic near passenger railroad stations can be computed.

Freight stations must be included as major factors in creating street traffic. The total tonnage handled to and from any normal community has been found to be from 7 to 9 tons per capita per year. By a normal community is meant one with mixed commercial and industrial business—not a mining town or a Pittsburgh suburb which manufactures large quantities of steel products. As has already been suggested, a considerable portion of this tonnage is usually handled over private sidings or over waterways direct to or from factory or warehouse. A 25 per cent deduction for this diversion has been found to apply in several cities. There then remain between 5.3 and 6.8 tons per capita per annum which pass through freight stations and over team delivery tracks. Maximum monthly conditions usually run about 200 per cent of the average. Twelve tons per capita per year may, therefore, be taken as the annual rate, and the daily freight tonnage computed accordingly. The individual station tonnage must be considered in estimating local traffic conditions. Fuel moves generally

from special fuel yards and is, therefore, to be separately treated in estimating the resulting traffic. Building materials are similarly handled in great part. Sometimes foodstuffs go through a special railroad market. Household furniture belonging to new arrivals or departures of the population and some food for local centers often move through local stations. These items constitute about ten per cent of the total and can be estimated on the basis of the population naturally tributary to the local station in question. The traffic between the wholesale and factory districts and railroad freight stations is much greater and generally runs to 25 per cent of the total for the city.

HOTELS A SOURCE OF TRAFFIC

Other sources of concentrated traffic but only in a relatively smaller degree are large hotels and office buildings. Hotels create traffic from two principal sources—the arrival and departure of patrons as they move to and from the community and as they employ vehicles for local business trips. The initial arrival and final departure figures will depend on the relative proportion of transient business and the economic level of the patrons. The business use of vehicles by hotel patrons will also vary with the transient ratio. A second source of street traffic due to the existence of a hotel is its endeavor to make the utmost use of its accessory accommodations for special community functions like balls, banquets, bazaars, and other activities. These will originate traffic in proportion to the attendance, which can be computed as was that for theatres. Certain transient hotels in a western city had a complete turn over on the average every three days. Information received from the door men of several hotels leads to the conclusion that they are closely similar to department stores at about one-half the frontage rate except that special functions are to be figured like theatres.

OFFICE BUILDINGS AND CONGESTION

Office buildings are traffic points only in a minor degree. A certain proportion of the higher paid tenants of office buildings come to their offices daily in their own cars driven by chauffeurs. A few others drive from their homes to near-by garages. A few more (especially in the smaller cities) drive to work and park their cars all day as near their offices as possible. Among the clerks and other tenants of lower income scale, the use of automobiles is proportionately less, although the potential car use is about six times greater. Visitors to the offices of tenants are often greater sources of traffic than are the tenants. Investigations of the average floor space per regular tenant in many office buildings in a number of widely distributed cities disclose figures varying from slightly below 100 to over 200 square feet. The lower figure applies in the densest parts of New York, while the higher value is found where office space is not in such great demand. Even though the higher paid tenants will occupy proportionately more than their quota of 100 square feet of floor space per person, a first approximation to the traffic originated by an office building may be made by assuming the average area figure and applying to it the proportion of proprietors and firm members to the total office tenancy. This is found to be 17 per cent and by using the same method as that used in connection with the factory districts a figure can be computed to check against observed traffic data. Seventeen per cent of the floor space will create between 2 and 4 vehicles per day (average 3), while 10 per cent of the balance (83) will originate 2 vehicles per day.

On the basis of this assumption it is found that each 1000 square feet of office space will be equivalent to 6.76 vehicles per day. In other words, a 20-story building which occupied a whole block, 200 x 400 feet, would originate 10,816 vehicles per day counting them both as they come and as they leave. Of the 5408 vehicles which would carry building tenants, 25 per cent, it is assumed, would be garaged or parked in the vicinity. Assuming an average length of car of 15 feet, the cars would require 20,180 lineal feet of parking space. The total building frontage on all four sides is evidently only 1200. Housed in garages these cars would occupy 162,240 square feet, or a space equivalent to a little over two floors of the assumed building. The present day facts are that no such proportion of office workers use cars to go to and from work in the large cities and this figure is approached only under exceptional circumstances. In one apartment house in New York City in which each head of a family was a merchant or professional man going to an office each day, and of whom over 50 per cent owned cars and over 25 per cent employed chauffeurs, only 6 per cent used their cars to reach their offices daily. It may be contended that the parking and garaging problem and the excellent transit facilities in New York militate against the use of cars by office workers. Observations of the total numbers of vehicles which daily enter and leave the business and commercial centers of such cities as Indianapolis, Ind., Springfield, Mass., and Cincinnati, Ohio, show that only a relatively small number even of car owners among office workers use their cars to go to and from business even when other transit facilities are meager and poor in quality. Traffic tallies in many cities of the total number of vehicles which enter and leave the business district daily (excluding all through travel) is very close of one vehicle per family per day. In one city of about 150,000 population it was found that the rush hours morning and night (at which time office workers would be traveling) were only 30 per cent above the average hour figures for a ten-hour day.

Assuming that the whole of the rush hour traffic were to be considered as office workers, that the office area was eight blocks square with an average building height of four stories with two used for offices on the average, with buildings covering 75 per cent of the land area (outside of the streets), with blocks 400 feet square and a daily total traffic flow of 100,000 vehicles, that each automobile morning and night carried two persons, it is easily computed that only 17 per cent traveled by automobile. The assumption as to the 20-story building is thus found to be somewhat extreme.

The data as to rush-hour and non-rush hour traffic show that the amount originated by office buildings during the hours when visitors constitute the bulk of the movement is not as great as when the office workers are arriving and leaving. On the basis of the ratios already quoted it is estimated that the total non-rush hour office building and commercial area traffic is about three times that of the two rush hours combined. Since office buildings are usually devoted to merchandising on the first floor, that fact must be taken into consideration in all traffic estimation.

The foregoing analysis gives a basis upon which the relationship between traffic and building bulk can be studied.

For example, it has been estimated that a square one-half mile on a side with a street system like that in the borough of Manhattan, New York City, if built up with buildings to a uniform height would create sufficient

street traffic to fill the streets to capacity[2] if the buildings were of the following uses and heights:

Office buildings	16 stories
Loft buildings	9 stories
Department stores	6 stories

The enforcement of a zoning ordinance with height restrictions below those given above would consequently tend to preclude such a concentrated street use and thus would prevent congestion.

This illustration also discloses some of the difficulties inherent in the use of zoning restrictions with the intention of affecting traffic problems.

Since it is generally assumed that as to all buildings throughout any zone the requirements must be uniform, it is not possible to establish different height limits for different kinds of use. An average must, therefore, be employed. Again, except in very rare locations will an area one-half mile square ever be built up for any single type of use. And, in the example given, no allowance has been made for through or semi-through traffic.

As to through traffic, it has been found from traffic studies in Manhattan that only one-half the total traffic is of a local character comparable with that assumed in the example.

With streets already in existence and not easily widened, it would thus seem possible and necessary so to formulate any zoning ordinance as to preclude the creation of traffic congestion. Where streets may be widened without undue expense, then the street width and the adjacent building use and bulk should be so related as to provide the best economic arrangement. Such arrangement has been shown[3] to depend on the size of the community and on its shape.

VARIATIONS IN DENSITY OF TRAFFIC

As between a community with a single thoroughfare along which all business is done and a community of equal population, business, and area, arranged in the form of a circle, square, or even of a cross, there will be a very wide variation in traffic density even though all other factors except shape are constant. Table II shows the average haul from the center of a community of each assumed shape to all points in the area. The several assumed shapes are a single street, two streets at right angles, a square with streets run parallel with the sides, a square with streets run parallel with the diagonals, a circle with radial thoroughfares, and half square and semi-circle with the center on one side, and rectangles. An area of about one square mile has been assumed with lots about 100 feet deep and 33 per cent of the gross area devoted to streets. The figures are approximate, intended only to illustrate the relationship between the quantities involved.

Obviously if all traffic is assumed to start from the center and move to each point within the area, then the traffic at the center will be the total number of units which must be moved, divided by the unit load; and the number of loads will be the length of a working day divided by the number of round trips. It has been found that in residence districts about eight-tenths of the traffic should theoretically be of the passenger type which makes one round trip daily. The balance will supposedly be merchandise which will move throughout the working day. Careful observations show that vehicles are standing idle 58 per cent of the time on New York City streets, that

[2] Factors of maximum street capacity are given in *Highway Traffic in New York and Its Environs* by Lewis and Goodrich, p. 111.

[3] *Loc. cit.*, "Influence of Zoning" p. 469, 456.

TABLE II

Shape of Community	Relative Length of Average Haul (Miles)
Long street	9.96
Two long streets forming a cross	4.98
Square, with streets parallel to sides, distribution from center	1.13
Rectangle, twice as long as wide, streets parallel with sides, distribution from center of long side	1.59
Rectangle, twice as long as wide, streets parallel with diagonals, distribution from center of long side	1.41
Circle, streets radial and circumferential, distribution from center	0.94
Rectangle, four times as long as wide, streets parallel with sides, distribution from center	3.39
Semi-circle, streets radial and circumferential, distribution from center of diameter	1.28
Square, streets parallel with diagonals, distribution from center	1.00
Right angle triangle, streets parallel and perpendicular to long side, distribution from center of same	1.36

the average haul is close to one mile and that the average speed of travel is 12 miles per hour. Simple algebra shows that the number of vehicles required to move the merchandise will vary directly as a constant plus some multiple of the distance. Based on these facts the constant can easily be computed to be 1.38, and the number of commercial vehicles required to handle the merchandise in communities of the different shapes listed would be in accordance with the computation in Table III.

Where there is to be more traffic during a rush hour in any community more or wider thoroughfares are necessary to accommodate it.

TABLE III

Shape of Community	Proportionate Number of Vehicles at Center	
	Total Commercial All Day	Total During Rush Hour at 1/10 Commercial Plus Assumed Constant Passenger
Square, streets parallel with diagonals, distribution from center	100	100
Circle, distribution from center	97	99
Right angle triangle, distribution from center of long side	115	103
Square, streets parallel with sides, distribution from center	106	101
Semi-circle, distribution from center of diameter	112	102
Rectangle, twice as long as wide, distribution from center of long side	117	103
Rectangle, twice as long as wide, distribution from center	125	105
Rectangle, four times as long as wide, distribution from center	200	120

The length of average haul has been seen to vary with varying shape from 1.00 to 3.61 miles, but the corresponding variation in the traffic of the rush hour due to shape is theoretically only from 1.00 to 1.21. As a first approximation it may be assumed that the street system of all the type communities will bear a constant ratio to the gross area. Employing this assumption, and further assuming that the height is uniform throughout each community at any assumed figure, it is easy to estimate the variation in length of haul with a change in building height and area. Simple algebra shows that the length of haul varies inversely as the average building height. Consequently the number of commercial vehicles required is reduced with increased height. If the average building height is doubled the average haul changes in the ratio of 1.00 to 0.70 approximately. With the same population in the two cases, the same number of loads of merchandise and the same number of passenger vehicles would leave the center each day. Since the average haul of the commercial vehicle would be less, more trips per vehicle would be accomplished, but with the same total tonnage to be handled no more vehicles per hour would be counted.

In most communities the density of use varies inversely with the distance from the commercial center (plus or minus a constant distance). This density varies more rapidly than the change in building height, the latter being found in most communities to vary in steps which form nearly a straight line. Under such circumstances the haul from the center of the community to the center of bulk, of any portion on one side of the center of the community, changes from two-thirds of the radius of a circular city to one-half of the radius, approximately. Since the density of use changes in an even greater degree the actual haul is even less than one-half. In one roughly semi-circular city it fell to about one-third the radius of the area occupied with houses (down to a density of two acres per dwelling). This resulted in an average haul of about one mile. Since the same average is found in such widely varying communities as New York City with its several millions, and cities of about 150,000 in New England and Virginia, it seems a safe conclusion that growth which adds simultaneously area and building height to a city simply increases the traffic area and density without altering its average value.

It is obvious that short hauls for the delivery of commodities or the conveyance of passengers cost a community less than do long hauls. From this single fact it might be inferred that a compact community of small area covered with high buildings would be more economical than would a community which contained the same total building bulk erected over a greater area but at a lesser height. Further consideration discloses the additional fact that high buildings involve greater proportionate costs both for original construction and for annual operation than do lower ones. Other factors also must be included in the problem such as the value of time to passengers, the value of land for buildings, streets, parks and other uses, the value of money and of vehicles and of building operation. A considerable study of the problem led to the development of a rather complicated formula involving the third and fifth powers of certain variables, but capable of use to determine the optimum building height for communities of different sizes and for certain assumed values of the many factors which were employed. The work thus far completed has had to do only with an assumed circular city, in which all commodities are delivered

from the center to the householders who come to the center daily according to a given riding habit from their places of abode, which are of uniform height, first cost and operating cost. Table IV gives the several factors assumed, the symbol employed, and the numerical value assigned for study purposes after a considerable investigation of the average values and the spread of each one.

cost of passenger transportation except as it is included in the value of the time of the passenger. Were these to be included it would be necessary to be more exact in selecting numerical values, and the further computations showed that even some of the factors included have an immaterial influence upon the results for ordinary conditions. Since the formula is based on the assumption that there exists only a

TABLE IV

Factor	Symbol	Assigned Value
Height in stories of all residence buildings	s	Variable.
Radius of city	r	Variable with S and P.
Height of each story (in feet)	h	10 feet.
Volume of buildings (per person)	v	1,000 cubic feet.
Population (total)	P	Variable.
Area for parks, schools, etc. (per person)	k	200 square feet.
Area for streets (per person)	t	$t=2/3\ (k+v/hs)$.
Land value (average)	e	100 per sq. feet ($1).
Annual cost of building operation	p	12/100 (12 per cent).
Annual cost of land holding (gross)	x	6/100 (6 per cent).
Tonnage of commodities (per capita per year)	T	4 tons.
Average ton-mile haulage cost	y	15 cents per ton mile.
Passenger riding habit (factor of P)	m	P/10,000 = annual riding habit.
Average speed of passenger transit	a	1,000 feet per min. (12 miles per hour).
Value of time of average passenger	e	1 cent per minute.
Cost of housing one story high	c	19 cents per cubic foot.
Factor of increased housing cost per added story	n	1 cent per cubic foot.

The total annual cost per capita of the items enumerated is given by the following formula:

Cost per capita =

$$2/3\sqrt{P}\sqrt{\frac{5}{3h}}\left(P\frac{e}{am}+\frac{Ty}{5280}\right)\sqrt{\frac{v}{s}+hk}+pv\left(c+n\frac{s+1}{2}\right)+x\,1\left(\frac{v}{hs}+k+t\right)$$

From this formula have been omitted a few items sometimes included in discussing this subject qualitatively, but they are believed immaterial in proportion to those included. Among such omitted items are the time occupied in vertical transportation by residence elevators, the radius of the assumed central office, business and distributing center, the single, central distributing point, it can logically apply only to communities of a few hundred thousand at most, because even in cities of 100,000 population there are almost invariably several local freight stations and numerous local business districts. Nevertheless, it is interesting to discover what the formula would give even for cities of several millions under the assumed conditions. Substitution of the numerical value of the factors given in the table reduce the formula to one which

involves only P (total population) and S (average residence building height in stories). The easiest method to pursue in solving the cubic or quintic equation which results is substitution of values for P and then by differentiation with respect to S, equating the result to zero and solving for S, finding the height which will give the minimum per capita cost. Computations made in that way revealed the following results:

TABLE V

Total Population	Optimum Residence Height in Stories
10,000	4.4
100,000	4.5
1,000,000	4.9
2,500,000	6.0
6,250,000	10.2
10,000,000	14.0

Slightly over four stories is seen to be the economic height even for the smallest community, and little change occurs until 1,000,000 population is passed. Thereafter the height rises rapidly with increase of size. In this connection it is interesting to discover from the New York City building department records that the average building height in the borough of Manhattan was 4.8 stories in 1912 and that the average height of all buildings for which permits were granted during the intervening period down to 1924 was also 4.8 stories. This average was not weighted for building area but this would have small effect when it is known that only 1,048 of the 92,749 buildings disclosed by the 1913 summary were over 10 stories high. Assuming 12 feet as the average story height above the street gives an average building height of 58 feet. It is interesting to compare this figure with the height limitations in Paris and London which are 65.6 and 80 feet respectively. Data as to the heights in stories show an even closer similarity—New York 4.8, London from 4 to 5, Paris just below 5. Since the averages in those cities are somewhat below these limits it is seen that the average building heights in the three largest cities of the world are substantially alike, and that they are very close to the theoretical figure which would result in a minimum gross annual community cost.

Decentralization—Eventually but Not Now

By Jacob L. Crane, Jr.
Planning Engineer, Chicago

AMONG city planners decentralization is now a magic theory for curing the more serious defects in the physical growth of our cities. As related specifically to the problems of traffic congestion the proponents of this theory submit three propositions. First, they maintain that the usual process of city growth by building upward at the center and by continued accretive growth at the outer periphery, with remedy for the increasing traffic congestion by street widenings and openings, is an endless circle, where the relief measures fail to eliminate the cause of congestion and may even create more congestion, requiring in turn additional relief. Second, they claim that since this type of city-building must fail of a genuine final solution of the traffic problem, a fundamentally different theory must be applied, and that decentralized city development, in contrast to accretive growth, supplies that theory by removing the cause of the continued multiplication of traffic congestion and curing the disease at its source. Third, they believe that decentralization has or will set in in the larger cities, and that it may be hastened and guided by intelligent *regional* planning. The purpose of this paper is to briefly test the soundness of these conclusions in the light of the author's observations and prejudices.

Rationalization is liable to error in a study of this kind, where a special student may be out of sympathy with the blind, unconscious, but dominant purposes of a big city development. Much of the criticism of traffic congestion is heard from individuals, the author among them, who temperamentally dislike overcrowding. Further, there are probably obscure but powerful impulses driving us on to the megalopolis of greater and greater congestion (Spengler).[1] However, it is widely acknowledged now that beyond a certain point traffic congestion is uneconomical and undesirable, and that the point of diminishing return has been reached in most big cities. We may, then, examine our first proposition, the inadequacy of the "more and bigger streets" theory, as applied to the actual traffic situation.

Traffic in the Centralized City

Traffic piles up at certain points in the streets of typical modern cities because it flows in a manner diagrammatically illustrated in Figure 1. Passenger traffic flows between homes and working places, shopping centers, and amusements; and commercial traffic flows back and forth between business, industrial, and residential areas. In general, the larger a city grows the greater the traffic congestion becomes. Although the percentage of streets to total area is approximately the same in cities of all sizes, as a city grows larger the *traffic intensity constantly increases because of the greater area sending traffic to the central points, because of the greater density of land occupancy, and because of the greater interference of traffic necessarily flowing*

[1] Spengler. *The Decline of the West.* Knopf 1926.

through points of congestion in passing from one section to another.

Under the theory which we are examining, when street "A" in this type

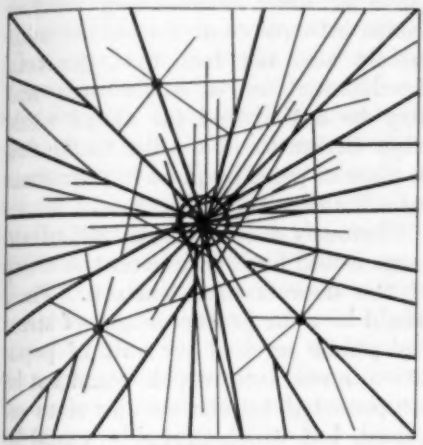


FIGURE 1

of city becomes overcrowded relief could be given, say, by widening that street. But in practice when "A" is widened the new traffic capacity usually makes more and higher buildings and denser land occupation *profitable* along the widened thoroughfare, and that possibility is soon taken up. Witness the Wacker Drive improvement in Chicago, and dozens of others. Such an improvement may divert traffic from other overcrowded streets (as Wacker Drive does), but at the same time may also create congestion at new points—Wacker Drive at Michigan and at Lake Street, and the Outer Drive connections to Michigan Avenue at Monroe and at Randolph.

Meanwhile, the accretive growth of the city pours more and more traffic into the congested areas, which, along with the overbuilding adjacent to the widened streets, necessitates more openings or widenings. I say overbuilding because even though in theory city zoning controls the density of land occupation, no big city zoning ordinance in America establishes a low enough density to bear a reasonable relation to street capacity. And so the process seems to go on in an endless circle: more buildings, more streets, and again more buildings, and again more streets. The central districts go up and the periphery pushes outward, and so long as the city pattern remains of essentially the same type a city might build up and out until all of the downtown district would necessarily have to be devoted to streets, perhaps in two or three levels.

Of course, ultimately, no final relief being found in the application of this endless process, the "natural" limit is reached. But the forces for concentration are so powerful, forces created by existing transport, street, and transit facilities, by the conveniences of centralization, by the exploitation of land values, and by the "bigger city" psychology, that only such counter forces as those set in motion by unbearable confusion and delay and exorbitant rents bring any counter tendency. Apparently the process goes on until the actual rate of diminishing return in public economy and in the amenities has long been passed. And the city planners seem to be justified in seeking a new theory for solving the traffic problem.

THE PATTERN OF DECENTRALIZATION

Decentralization is the name given to the theory of city building which is proposed for a real solution. In a city of the decentralized pattern only such central administrative and cultural activities as pertain to the whole community would be placed in the downtown district—clearing houses, general industrial management and sales offices, and central hotels, museums, theatres, etc. All else—manufacturing, most retail business, local banking, branch libraries, and nearly all residence, would be distributed in

secondary foci, laid out and controlled in a designed relation to street capacity. And as each local area reaches its reasonable complete development new ones, separated from the others, would be opened up. A central area could readily be reserved large enough to accommodate the central uses for a decentralized city of any size (area or population) within reason. The "loop" in Chicago takes up only about one-tenth of 1 per cent of the area of the city, less than a quarter of a square mile, and that is partly occupied by manufacturing and storage buildings. The basic idea of decentralization, then, is the controlled and *limited* development of an indefinite number of interrelated cities, each for special or for mixed uses, with a "hub" of limited purpose, in contrast to the unlimited growth outward and practically unlimited growth upward of a single huge city area. For such a decentralized city the traffic flow would more resemble Figure 2 than Figure 1.

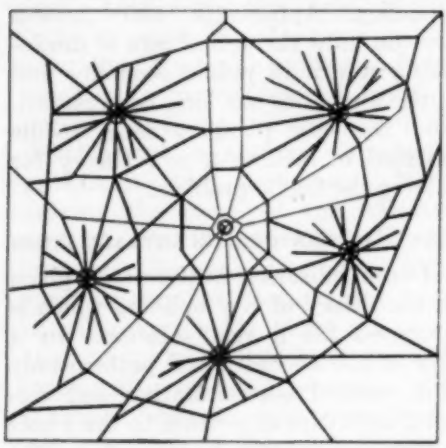


FIGURE 2

This theory of city building would seem to break the fatal circle of the more and bigger street theory as the latter works out in a city of accretive growth. *By taking a defined land area and applying to it a limited character and density of use, it is possible to design and build a system of streets to handle the maximum development of traffic in the area.* Even if the aëroplane or some other traffic machine comes into common use as the automobile has, the fact that the total development of a single area unit may be anticipated far ahead would allow design for a specific traffic flow in place of piece by piece improvement for a limitless traffic increase.

Obviously disadvantages and advantages would both be inherent in a city of the decentralized pattern. There would be a far greater length of street and public services per unit of population, a cost item which would not be compensated by the smaller sizes required, but which probably would be compensated by the saving in making unnecessary the great expense of street widening projects in the other type of city. Wacker Drive, a mile long, cost about $26,000,000,[2] enough to build seven hundred miles of concrete country road or two hundred miles of fully improved city street. The circle of population centers would be farther removed from the downtown administrative and cultural area. But while not over 10 per cent of the entire population would travel to the downtown district each day, every workman, family shopper, school child, and movie fan would presumably be much nearer his daily objective and could reach it over comparatively uncrowded streets. The gross saving in carfare or auto use, and, more important, in nervous energy, would be enormous. The limitation put upon the development of each nucleus might hinder the expansion of some huge industry. Suppose Gary, Indiana, now a city of 100,000, had been limited by control of

[2] Hill and Crane. "Discussion on Increasing Street Capacity." *Transactions American Society Civil Engineers*, Vol. 88, p. 224.

land area and density of land use, to a population of 50,000 people in conformity with the English Garden City ideal. My feeling is that it would be better to pay an added tenth of a cent per pound for steel, made necessary by dividing the steel works between two towns, than to bear the costs of congestion and delay and of eventually having to rebuild an overcentralized Gary district. The decentralized, regional city would, if consistently controlled, make impossible the exploitation of grossly overbuilt land areas. I would be glad of that, but the average American citizen to whom land exploitation is the great outdoor sport might be expected to object. There would be less occasion for the large expense of wrecking and rebuilding that goes on in the typical city of shifting districts, poor land planning, and cheap building construction. Less noise and dirt, more light and air and open space, and a more cohesive spirit would accrue to each subcommunity of the great regional city.

It is imagined, I believe with fair justification, that an orderly, economical development would be possible under a regional plan for the decentralized city, in which the location, size, character of use, and communications for each section of the regional area, and for the entire region, were determined in advance. Altogether, it may reasonably be claimed that the theory of decentralization, *if feasible to put into practice*, would break the circle of city extension and traffic congestion, and that it would result in a more desirable and more economical pattern of metropolis.

IS DECENTRALIZATION GOING ON?

The factors involved in the third point, that of whether decentralization is actually taking place, are difficult to appraise. On the affirmative, we have some evidence of industrial decentralization: the selection of outlying sites for some of the larger recent industrial establishments or groups of establishments, *e.g.*, in the Chicago district the big Johns-Manville plant forty miles north, the Ford plant south, and the steel and refinery development in the Calumet district; and for New York, Professor Haig's conclusion: "These figures appear to furnish grounds for the belief that the peak of manufacturing in the center of the city was reached about ten years ago, and that a process of decentralization is already under way."[3] We have the reported success of the transfer of the Indian Refinery operations from New York to rural Illinois, and of the Ford automobile parts factories from Detroit to small settlements in Michigan. There is a distinction here between the movement of heavy as contrasted to light industries, the former tending to move far out and the latter to remain closer in.[4,5]

For the matter of residential decentralization we have the figures indicating rapid suburban development. According to the federal census reports the city of Boston increased in population about 12 per cent from 1910 to 1920, while the metropolitan district outside the city increased 19 per cent; for New York the figures are about 18 per cent for the city and over 27 per cent for the metropolitan district outside; for Philadelphia, 18 and 34 per cent; for Detroit, 113 and 255 per cent; for Chicago, 24 and 76 per cent; for Cleveland, 42 and 108 per cent; for Seattle, 33 and 131 per cent. Many

[3] Robert Murray Haig, "Toward an Understanding of the Metropolis," *Quarterly Journal of Economics*, Vol. XL.

[4] Economics and Industrial Survey, Regional Plan of New York and Environs.

[5] Dr. Ing. R. Heiligenthal, *Proceedings International Conference on City and Regional Planning*, 1925, p. 131.

individual suburbs within these metropolitan districts showed a phenomenal growth during the same period.

What looks like a tendency for retail business to decentralize is shown in the growth of business from 42nd Street to 59th Street, in the Bronx, and up in Westchester for New York, and at 63rd Street on the south side, Wilson Avenue and Howard Street on the north side, and in the closer suburban towns for Chicago. Indeed, every large city offers many examples which seem to indicate decentralization tendencies of various types: the Country Club District in Kansas City; the industrial development of the Long Island and New Jersey towns; the transfer of many industries to points nearer sources of materials such as cotton textiles to the south, lumber and furniture to the northwest, and steel to Alabama. However significant these tendencies may be, they have been accelerated in the last twenty years by the introduction of important facilities making possible the movement outward of industry, business and residence: belt line railroads giving switching access to many trunk lines; the automobile; new highways and transit lines; telephone and radio for communications; and high tension power lines (super-power) making cheap, flexible power available to areas formerly unsuitable for industrial works.

The persistence of the forces acting for centralization is evidenced by the continued peripheral growth of residence and industry, and by the tide of downtown skyscraper construction. More new factories are locating or relocating within or close to the built up cities than are going far outside. The population growth of the outer sections of the cities themselves has, in many cases, exceeded the population growth of the suburbs both on the percentage basis and, more significant, on the basis of gross numbers. The population density per unit of land area, and the proportion of apartment house dwellers steadily increase. The suburban development strings out on radial lines, clinging closely to rapid transportation and good highways, and the suburban population, under the necessity of going to or passing through the central districts for business or pleasure, adds a considerable item to the city traffic congestion.

On examination it appears that the decentralization tendency so far is only a forced driving out of industry, business and residence to areas destined to become part of the centralized city or part of secondary uncontrolled centralizations, and whatever decentralization has taken place goes on without organized allocation or arrangement of land areas. I conclude that true decentralization in the meaning of the term as used by city planners is not sufficiently under way to justify much enthusiasm about its progress.

REGIONAL PLANNING FOR DECENTRALIZATION

Can city and regional planning, then, working as they must through public agencies, cause a true decentralization to take place? Forces as powerful as, and working counter to the forces of centralization, must be set in motion. Some of the factors above mentioned such as super-power and the advantages of removal to sources of material are unquestionably operating of themselves. But most of the forces based upon the other public and quasi-public facilities and upon the element of private profit continue to work for centralization.

To bring about decentralization, the railroads and commercial highways, and particularly the terminal facilities,

must be rearranged first of all.[6] Most of the development facilities (main railroad lines and terminals, streets, and highways, trolley and bus lines, power and water distribution mains) have been laid down on the anticipation that all new development would be added consecutively to the old, and to rearrange them would critically affect the existing investment and the property values dependent upon them. And the public agencies are generally too responsive to the rights of property ownership to even question the continuing effect of the centralizing forces upon city development.[7] At a zoning conference in Chicago a responsible transport engineer made the remark that sensible zoning to reduce congestion would be possible only if the transit and street routes were rearranged to divert traffic from the centers of high property value. But the owners of this property can and do effectively prevent any such rearrangement.

While most planning commissions and associations, city and regional, understand the theory and advantages of decentralization they have been able so far only to recognize the centralization forces and to plan for their alleviation and not for development directly counter to them. These planning agencies will be able to accomplish only so much as the private property interests will come to see as advantageous to them. Such ingenious decentralization programs as that proposed by Comey[8] would run afoul of the difficulties of working on private land through public agencies. Assuming that our public policy toward private land remains essentially unchanged, it seems evident then that such experiments in decentralization as those being carried on by Ford in the smaller Michigan towns and those at the Garden Cities in England, where the factors of cost in an enterprise for private profit may be worked out, are of far greater value in the study of the possibilities for decentralization than all the city planners' theorizing and promotion. For bringing about the decentralization of our American cities the next move is up to the industrialists themselves. If they find that decentralization under organized planning and control is to their advantage, then planning boards can make their designs accordingly. Even if the experiments in industrial decentralization prove successful the process of educating other manufacturers and the public at large will be a long one. At the best, one or two generations will be required for the reorganization of our cities on the decentralization pattern.

It must be remembered, however, that the American city is virtually rebuilt—buildings, streets and communications—every generation or so, and that if it takes only as long to remake them on the decentralized pattern as it has to build them under the centralization impulse they will still, at the end of that time, be young towns. Meanwhile study and discussion may help to find means toward the desirable end. For example, a suggestion has been made[9] that the London County Council (we frequently take city building ideas from Europe and adapt them to our uses, for example, City Zoning) use its granted powers to buy suburban land and develop it on the decentralization theory. German and Scandinavian cities, notably Ulm and Trondhjem, have been carrying out municipal land programs for generations.

[6] Dr. Ing. R. Heiligenthal, *Proceedings International Conference on City and Regional Planning*, 1925, p. 131.

[7] Stuart Chase, *Survey Graphic*, Vol. 7, No. 2, p. 143.

[8] Arthur C. Comey, *Regional Planning Theory*, the Author, Cambridge, 1923.

[9] E. G. Culpin, *Journal Town Planning Institute*, Vol. 13, No. 6, London.

But, on returning to the specific urgent problem of relieving traffic congestion, we find little immediate comfort in the decentralization theory, even though the ultimate solution of the problem probably lies in that theory and in no other. It may require fifty years for the decentralized city to begin taking form. By that time, if present tendencies continue, the traffic congestion on our city streets will be unbearable beyond imagination. This condition will of course drive us to decentralization the sooner, but it is the manufacturer, responding to the possibility of greater economy in production, who will necessarily prove whether a genuine decentralization is written in the book of destiny of the American cities.

Planning Organic Cities to Obviate Congestion

Orbiting Traffic by Hexagonal Planning and Intercepters

By Noulan Cauchon

Chairman and Technical Adviser, Town Planning Commission, Ottawa, Canada

CONGESTION of living, housing and traffic is the cancer of modern civic growth. Much research has been expended upon the problem from the hygienic, the sanitary and the traffic angles by many patient investigators.

Cross Intersections

An analysis of the above conditions reveals the trouble as regards traffic to be in a defect inherent in our "orthodox" checkerboard plan of streets, in which the interminable pattern of cross street intersections involves a generalized condition of intermittent interferences.

At a cross intersection of two streams of street traffic there is always a minimum of sixteen so-called, "collision points" (see diagram No. 2) which may be better described as potential *interference points* in view of the peculiar phenomena that enough of us have escaped extinction to enable discussion of ways and means of remaining alive despite "latest new models" in Cylinders and Nascelles. It is easy to see that at a cross intersection when the traffic is moving at capacity on one street it is necessarily stationary on the other—and vice versa. Therefore, the greatest theo-

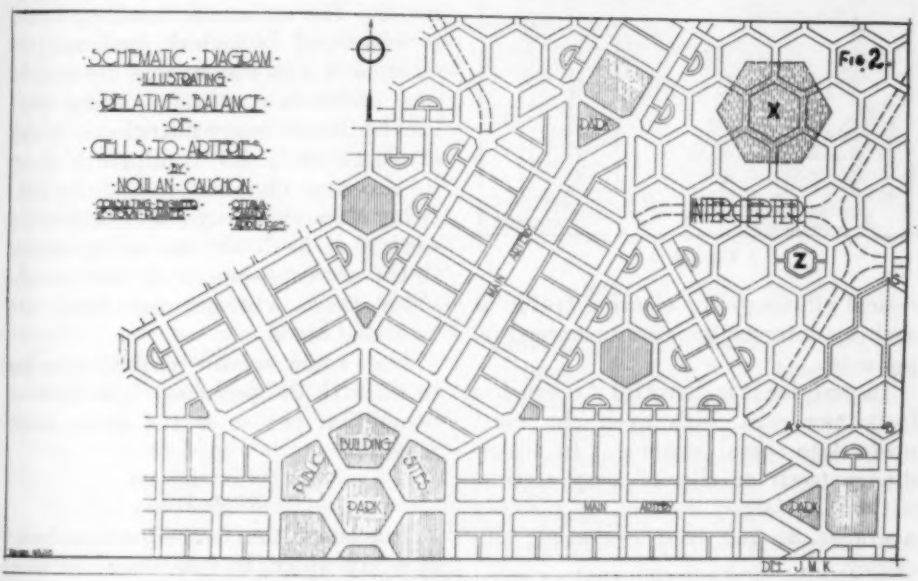


Figure 1

Note.—Ratio of business rectangle to residential hexagon. "Z" Hexagon cell—playground. "X" Non-Taxable "use"—all street frontages tax-bearing. "Intercepting" arteries: Half-mile interval adits and exits. Traffic convergence diffused by "baffling" over "central area" vs. congestion at a "central point." The "Interceptor" is a fast grade-separated highway with adits and exits only one every half mile.

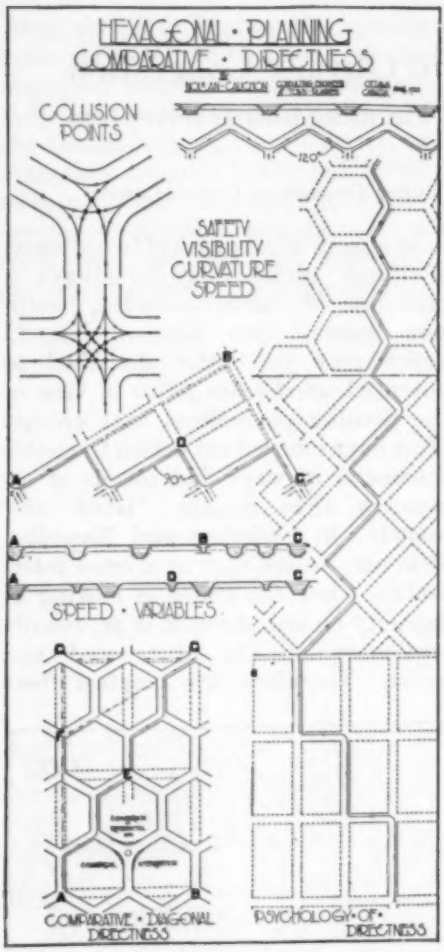


FIGURE 2

retical efficiency for clearing traffic at such an intersection cannot exceed 50 per cent.

In practice it is doubtful if it reaches forty per cent with even the most up-to-date signal systems. In an ordinary town or city of busy streets, without enforced control, it possibly averages 30 per cent operating efficiency.

Now a "chain" of traffic control and distribution "is no stronger than its weakest link"; and where such a system exhibits the property of weakness increasing concurrently with the acceleration of its growth, and where the efficiency of this system normally approximates 30 per cent, rarely approaches 40 per cent and can never by any chance in practice reach 50 per cent, nor ever even theoretically exceed this, it would seem time and wisdom to seek a possible substitute;—Economics.

THE NATURE OF THINGS

May I digress for a moment to the nature of things before their details; I take heart in teaching that Town Planning is the technique of Sociology—and from a philosophy of it that Ethics, Economics and Expression (Art) though different, yet are indivisible manifestations of Natural Law—the maintenance of life—human life.

Civilization is but a synthetic organization for the maintenance of that Law of Life—of survival and enhancement. The essential, therefore, is the provision of biological medium (environment), in which such life can be and thrive in continuity; there must also be the necessary nutrition of which sunshine with its comforting heat, its cheering illumination and its sanitizing ultra-violet rays, no less than the oxygen of fresh air, are indispensable to the accomplishment of that metabolism which changes our food into flesh and blood.

May I now submit what all this has to do with the problem—it is because congestion per se is the great *interference.*

CONGESTION

It is congestion in the business heart of a city which, by retarding and slowing down traffic movement between business and home, reduces the economic *time-distance* and thereby the area accessible for homes, which creates the high cost of living.

Thus the gradual lessening of this home area by the drawing in of its time-space boundaries, further aggravated by increasing population, forces *living to pile up* inefficiently in overcrowding and in darkness—causing *slums* vs. *spreading out* in that sunshine and fresh air which affords health, efficiency and amenity.

What is needed is a plan system, the street pattern of which will have the inherent property of diffusing traffic forces vs. confusing them, as results from our existing rectangular device of a checkerboard of streets which is really a vestige of prehistoric two-dimensional thinking.

THREE-WAY TRAFFIC

To free the problem of personal equations let it be transposed into dynamics—the play of impersonal forces.

If traffic—people and motors—be sensed as particles of "matter" moving in time and space and our hexagonal city as a sort of gravitational field in which these forces are constantly being deflected by three-way junctions there should be induced a generalized condition of orbiting.

There is a limitation, however, in that the traffic orbits will of necessity be confined to one or two parallel horizontal planes, the streams of each crossing one another at junctions of three possible collision points—a latent deficiency which can nevertheless be minimized I believe by a conventional precedence in acceleration and control as will be explained later.

It is the constant deflection of cosmic forces by gravitational action which induces them into orbits, and obviates interference "motor accidents" to that flapper Venus and her sheik Mars!

SPEED WITH SAFETY

Figure No. 3 shows the great visibility of approaching traffic and the possibility therefrom of avoiding interference. Further with this increased visibility and length of approach, if there be a convention established that the motorist having the right of way shall, when signifying his intention of exercising it, *speed up*, he will thereby relieve from slackening delay the motorist over whom he has precedence.

From Figure No. 2 it will be seen that the theoretical speed variables in the rectangular system cannot be bettered in practice as speed must be

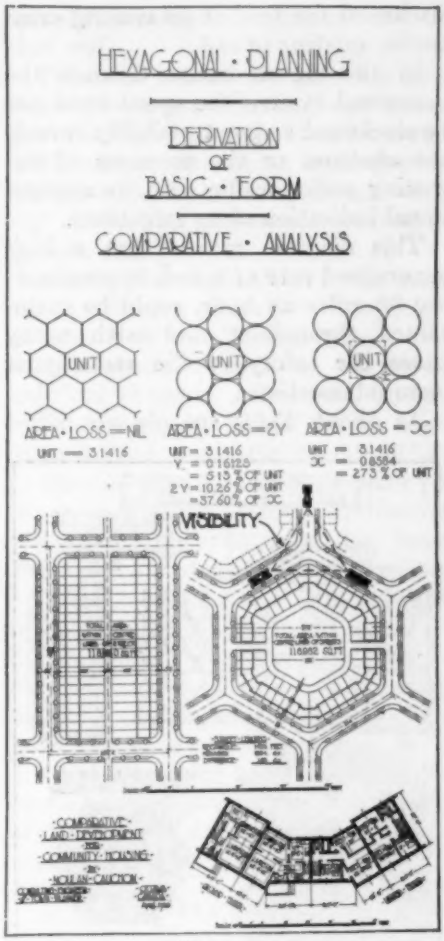


FIGURE 3

NOTE.—Visibility—160 feet.

slackened for fear of on-coming cross traffic, existing or not.

In the zig-zag route through the hexagonal system the speed need not be slackened as great visibility reveals the absence, or the presence of on-coming senior traffic with its conventional indication of its intentions.

This diagram means that a high generalized rate of speed, approximating 30 miles an hour, could be maintained throughout and with many times the safety of the rectangular cross intersections.

As about 25,000 people are killed annually in the United States in motor accidents, largely at intersections, any system which would reduce this death rate in future development claims careful consideration.

Figure No. 4 exhibits the paradox that the zig-zag route is about three times as fast and many times safer than the straight route with its inherent interferences. Admittedly it would take a long time to convince the man in the street of this, but the beginning of a model garden suburb, so planned by those in authority, would soon demonstrate the advantages of applying four dimensional thinking to town planning, in terms of time-distance.

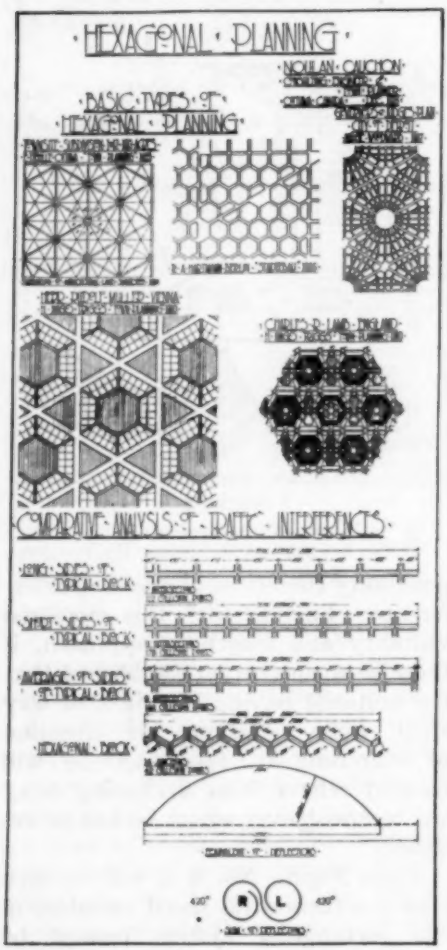


FIGURE 4

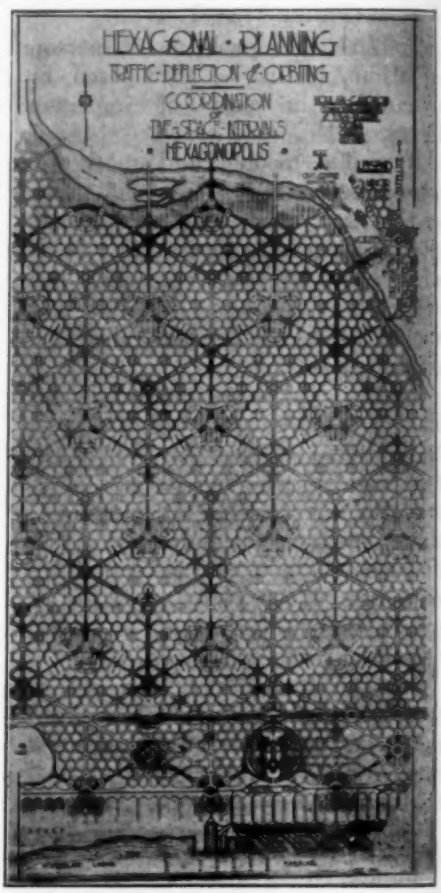


FIGURE 5

EFFICIENCY OF DISTRIBUTION

In Figures Nos. 5 and 6 the "ward" unit surrounded by rapid electric and motor ways is a mile across. Each "ward" is served by a commercial broadway, 100 feet wide extending from the centre in three directions, having surface street car service and approximating 5 per cent of the street lengths of the ward.

There are major highways 70 feet wide extending from all exits from the grade separated "rapid" way. The adits and exits from the "rapid" are at half mile intervals in each direction.

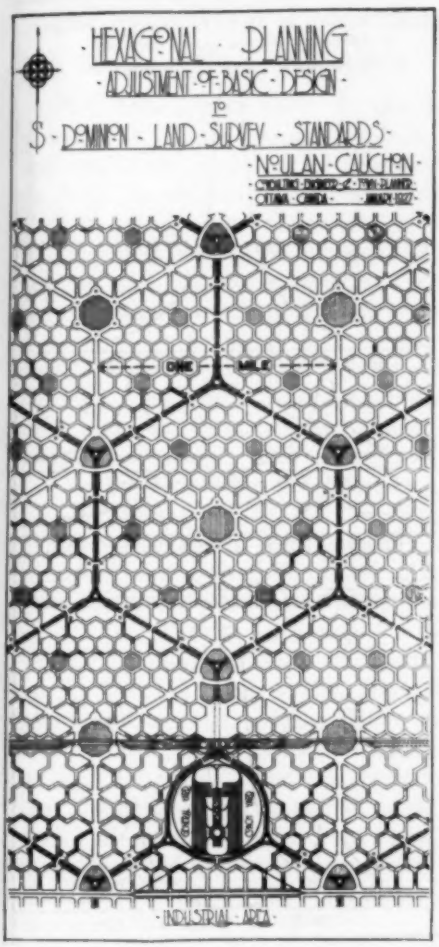


FIGURE 6

Minor (residential) streets are 50 feet wide.

Provision is made for creating large areas for non-tax paying institutions, parks and playgrounds—free from taxable local improvement frontages—at the junctions of the "rapid" and without dislocating the organic routing of general traffic.

Figure No. 6 illustrates the automatic diffusion of traffic—"the paths of least resistance" being four: A 100-foot commercial broadway having local tidal shopping movement, surface street cars and average traffic speed 10 miles per hour; the minor 50-foot residential streets 15 or more miles per hour; the major 70-foot distributing arteries average 30 miles per hour; the rapid with double electric trackage "express" service and a fast motor one-way road on each side, speed 40 or more miles per hour. It will be noted that everyone is within easy distance of the choice of ways and speeds to go in each direction.

These diagrams are theoretical yet elastic in adaptation to topography at the discretion of the city planner and engineer.

THE CRUX

The crux of the solution offered is the three-way junction, *i.e.*, *deflection* vs. the cross intersection, *i.e.*, *interference.*

The Hexagon block or "cell" was not chosen, it evolved from the only assemblage of three-way junctions in continuity without interstitial loss of area use (see Figures 7 and 3). Yet the hexagonal "cell" has worthy properties on its own account.

Figures Nos. 7 and 8 illustrate and compare rectangular with hexagonal planning and the breaking down of traffic peaks which would result from the deflection of forces vs. their opposition and interference.

HEALTH PROPERTIES OF HEXAGONAL BLOCK

(Note Figure No. 3.)

Stipulated that the hexagonal "cell" be pointed North there ensues avoidance of all east-west streets which deny sunshine to their southern fronts during winter.

In the hexagonal street system the sanitizing sunshine with its ultaviolet rays covers and penetrates all streets and shines upon all walls and windows some time each day at all times of the year; this being of increasing importance the farther north the latitude.

The wide-angled courtyard affords shape for sunny and airy playgrounds and keeps children off the streets.

The three-way junctions surrounding the hexagon greatly reduce danger from accidents.

The hexagon block takes 10 per cent less street around it than the equivalent rectangular area, *i.e.*, 10 per cent less local improvements such as sewers, mains, pavements and sidewalks, etc. (See Figure No. 3)

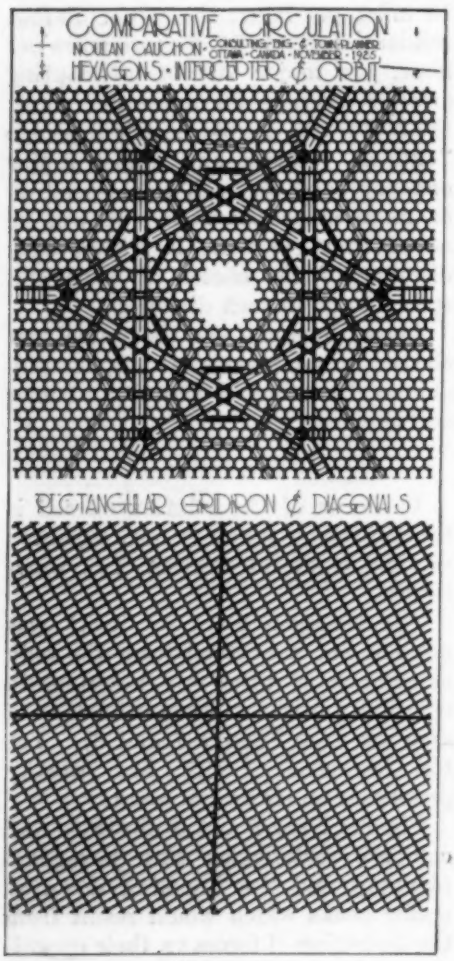


FIGURE 7

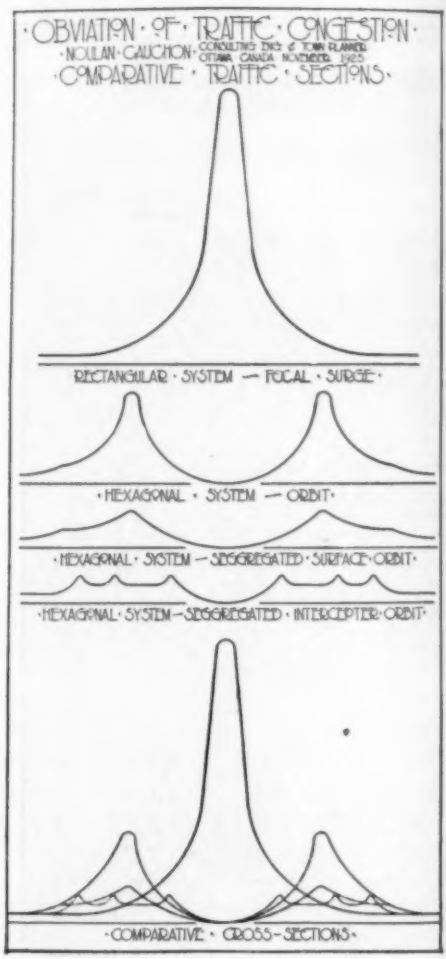


FIGURE 8

Overcoming Difficulties in City Planning Administration

By J. T. Woodruff

Consultant, City Planning Board, Springfield, Mass.

PLANNING is one thing. Doing is another. Public recognition of planning activity depends on actual successful demonstration of practical planning. Many schemes never get beyond the date stamp. Many more never overcome the embarrassment of finding themselves in a waste basket.

Reasons for Failure

Why does a plan fail? In the first place isn't failure caused by lack of reasonableness and lack of relation to existing conditions? A traffic plan that is poorly studied, badly related to the general city plan, unregulated by zoning, will fail sooner or later. Zoning carries untried potentialities for governing traffic flow. The degree of control over population distribution through use, height, and area regulation, gives the most delicate check on traffic generation. The older form of zoning for protection must rise to the newer form of zoning for the control of the master plan. Zoning deserves a place far greater than it has been given. It is really the foundation of all planning. It will take such a place only when city planners learn to use it as such. Until it takes such a place few plans will be successful. The reason is obvious. Lack of relation between parks, industries, business residence and traffic will defeat the purpose of each. Failure may be caused then by lack of reasonableness and lack of relation between the traffic plan and the city plan.

Another cause for the failure of a plan may be an incompetent planning board—a board that makes a means of personal gain out of the job. Planning boards should not be too large, yet should well represent the city as a whole. They must embody a very high type of citizen. If the job is a paid job it will sooner or later flop and become a political plum. This applies whether the planning board is planning for traffic or for any part of the city plan. What is a good board in one town may be a bad selection in another. One city may have a leader or a group of leaders that have a reputation for doing a good job with whatever they tackle. In another city the government itself may do an excellent job. The problem is to know the public and the government and make a wise selection of personnel for the sponsoring body. Anything new about this? Of course not — just common sense.

The third main cause for failure in city planning work is the not unusual idea that the whole thing is a secret. Many plans that are made are thoroughly understood by the few that are closest to them, are highly reasonable, well done, and yet fail because they have never been introduced to the public. I am one of the dwindling few who remember the task of getting a colt introduced to a steam roller. There was nothing wrong with the steam roller. It was a fine piece of machinery, performed beautifully, was powerful, substantial, lasting, and most useful. There was nothing wrong with the colt, yet every time the colt came

near the machine there was a great rumpus. It took a long while to get that colt to understand that steam roller. He had to look it all over, go around it ten or twelve times, and then just when I thought he was ready to take it for granted it made a funny little sizzle and he was off down the road lickety larrup for a mile or more before we got down to a steady gait again.

The public will shy at a new idea until they have seen enough of it to realize that it won't hurt them. Then they will be indifferent until they find out that it may be beneficial to them—then they will work for it. Traffic plans and city plans fail because they are not understood. Having decided to thus limit the obstacles to city planning administration, let us consider some of the necessary elements to successful administration

ELEMENTS IN A SUCCESSFUL CITY PLAN

A well-made City Plan, each part of which is coördinated with every other part and the whole governed by a zoning scheme that will assure its success, is the first essential. All the various controlling factors, social, religious, political, industrial, commercial, county, and state should have been in touch with the plan while it was in the making. What earthly good is a local highway plan for a city, kept within city bounds, if the state highway department never heard of it or was never consulted. It must fit the major plan for state and region if there is one. If there isn't one it is the duty of the local planning bodies to see to it that one is started. Zoning is the only legal safeguard for a plan. This fact should be realized both by city planners and communities. Less zoning for mere protection and more zoning as a plan foundation, is wanted. This will call for a high degree of technical skill and city planning technique and less commercialization of the profession, but it is the only sure way.

There is no way to get a good planning board except to get one. It can be kept small, however, and the various branches of the government having to do with parks, schools, highways, land subdivisions, sewers, water supply, and so on can directly or indirectly be represented on it and function to tie it in with their work. It can be kept on a non-paid basis, free from petty selfishness.

Last but not least the element of public contact can make or ruin planning work. Sympathetic coöperation of newspapers, illustrated talks before civic and social clubs, magazine publicity, a published plan large enough and attractive enough to go on any real estate office wall or in any bank and then actually put there will do much to make the plan belong to the people. High school classes in civics should be taught about the plan and should visit and see work on the draughting tables and under construction. Constant public attention will gradually bring about public coöperation from clubs and groups all over the city. The plan will gradually take form and its color and life will gradually imprint on the actual land.

In a large city all this cannot take place without organized effort. A full-time office or meeting place for public understanding is an absolute essential. If the person with a grievance, usually imaginary, isn't set straight or the grievance immediately remedied, much damage can be done. This public meeting place is the pulse of the whole city plan organism.

The doctor can't give the patient his best without personal contact. The city planning office gives this

opportunity. This office should build itself on service. If it is carried out along these lines the public will quickly respond, individuals and corporations will place faith and trust in the work and seek guidance and advice on matters relating to the development of their own land in relation to the plan. City officials will look to this office as the consulting office on municipal work. The game of politics will always be played. When it can be played with city planning information, a most fascinating game of permanent accomplishment results.

There is no receipt for successful planning administration that does not apply to any business. The plan should be a good one. The people back of it should be capable. The public should be educated to the plan. There is hard work all the way but the results more than repay for the labor.

Book Department

MOON, PARKER THOMAS, PH.D. *Imperialism and World Politics.* Pp. xv, 583. New York: The Macmillan Company, 1927.

In this stout volume Professor Moon has collected a vast array of facts relating to the military, political, and financial supremacy of the great world powers over the more backward peoples of the earth. Imperialism, the term popularly applied to this phase of modern development, is difficult to define, and the author, remembering doubtless Voltaire's *bon mot* that there is a latent tendency in the human mind to define a thing in order to avoid the necessity of understanding it, makes no attempt at a definition. In fact, while nations are quick to apply the term imperialism to the political and economic adventures of others, no nation acknowledges that its own activities are imperialistic, but always seeks to give them a humanitarian or civilizing aspect.

In giving a picture of modern imperialism, Professor Moon has undertaken to put together many specific incidents that have taken place in various parts of the world during the past fifty or sixty years, and to work them into one intelligible whole. This involves, as he says, "fitting together into one narrative such apparently unrelated persons as Gladstone and Gandhi, Roosevelt and Cecil Rhodes, Menelik and Mussolini, Kaiser Wilhelm II and King Thebaw." It means "combining in one story the Entente Cordiale and the Chinese Consortium, Dollar Diplomacy and pound sterling politics, alliances and loans, foreign missions and raw materials." It means viewing "as parts of one political panorama the Near East and the Far East, Mexico and Morocco, the Philippines and Fiji, Turkestan and Transvaal, Congo and Cuba."

In the body of the book the author tells the story of Africa from the day of Livingstone and Stanley to the present time, he states the recurring problems of the Balkans, of Turkey and of Persia, he describes the rivalry of the powers in the Far East and in the Pacific, and the recent advance of the United States in the Caribbean area.

As those familiar with the author's excellent Syllabus on International Relations (published in 1925) would expect, the present volume is based on an exhaustive use of a great variety of sources, and for a book containing such a mass of facts it is interesting and readable.

In the concluding chapter Professor Moon raises the question as to whether imperialism pays. His own opinion seems to be that certain industries, such as cotton and iron, reap most of the benefits. While indirect benefits may accrue to industry in general, it is impossible to calculate them precisely. Through the use of patriotic slogans and appeals to national pride, it is comparatively easy to arouse popular interest and win popular approval for imperialistic undertakings in which only relatively small groups of capitalists are interested. It is questionable whether the interests of the laboring classes are promoted by imperialism. The investment of capital in manufacturing enterprises in backward countries, where labor is cheap and easily exploited, brings about competition with home industries. "Thus capitalism is forever changing customers into competitors."

The moral aspects of the question are more difficult to determine and are discussed less fully. Attention is called to the fact, however, that present-day imperialism is becoming more and more associated with the idea of trusteeship, not only in the case of the League mandates, but in that of the colonies and dependencies of all enlightened countries. This holds a hope for the future.

JOHN H. LATANÉ.

LAUCK, W. JETT. *Political and Industrial Democracy.* Pp. x, 374. New York: Funk & Wagnalls Co., 1926.

This book will be of interest to labor leaders and employers. It deals with the various efforts to establish employee representation in industrial plants. Like most authors who have recently written on Democracy, the author experiences difficulties in defining his subject. In the main he understands by it the right of the workers to a voice in control and their right to improved conditions, such as good wages, short hours, healthful shop conditions, etc.

To many it will be a surprise to see the Ford Motor Company considered in connection with Democracy.

Professor Lauck starts out with the demand for greater coöperation between the workers and management which arose in the emergency of the Great War in all countries. Following this super-coöperation, there came a period of post-war reaction in which discontent was at its highest point. At this juncture, with one accord the more influential religious denominations of England and the United States proceeded to draft or re-draft their program of industrial and social justice, calling for a recognition of the workers' interests and opinions. Professor Lauck attaches deep importance to the fundamental ethical factors which were expressed by these religious programs. The Whitley Councils, established under war time pressure in England, afforded the precedents upon which later systems were built both in that country and in America.

The author then takes up the movement here and describes briefly twenty-two plans of employee representation. These range from a simple representative committee up to a member or two in the board of directors and a definite say in the labor policies. All of these plans are judged by what Professor Lauck calls the Fundamentals of Industrial Democracy, that is by such tests as:

Are the employees unionized, or may they join a recognized national labor union?

Are they given a real voice in the decision of labor policies of the company?

Are the wages, hours, and shop conditions well established on a high plane?

After an analysis of the twenty-two chief typical plans, Professor Lauck concludes that while many satisfy one or two of these tests, very few satisfy all. The highest standard is reached by the Mitten Men & Management system of the Philadelphia Rapid Transit Company. Here the basis of wage payment, hours, and employment conditions, etc., is highly satisfactory and recognizes clearly the right of the employee to share in the fruits of super-efficiency. The men are also given open participation in the government of the corporation, electing from among their number two to sit on the board of directors. While the Mitten plan does not involve direct dealings with a recognized national union, Mr. Mitten has made clear his entire willingness so to deal if at any time a fair preponderance of his men, say two-thirds, express themselves in favor of such a plan. Such a two-thirds vote has never been secured, apparently because of the entire satisfaction of the employees with the conditions which they obtain through the present system.

The author professes to be dissatisfied with the Mitten plan on one point—that it hangs upon one or two personalities and that a later management might deny to employees the right to affiliate with a national union, and thus destroy an essential element of democracy. To most readers this will appear to be a far-fetched supposition, but typical of those who insist that all unions must be orthodox and that all employers must deal only with orthodox unions. This is not the strongest part of Professor Lauck's presentation.

His sketch of the various systems of employee representation follows closely upon the lines laid down in the works of Myers, Wolfe and others.

The author's judgment of employee representation is, of course, affected by his attempt to maintain union orthodoxy. His general arrangement and presentation of material are admirable, and his effort to be fair is clearly apparent. Because of this strong effort his book will be liked neither by the conservative employer nor the "fundamentalist" union organizer. From the viewpoint of the old-line employer he has established too many labor "rights"; from the professional union viewpoint he has committed the unpardonable sin of selecting as the best existing type of industrial democracy a system which, while allowing men to join any union, does not compel them to join the only right one.

While this dilemma will deprive Professor Lauck of a definite, organized constituency in either camp, it will give his book a more satisfactory standing among those who desire to weigh and appraise the movement for employee representation at its true value.

The author says little or nothing about one aspect of industrial democracy which

deeply interests all students of political democracy, viz., How can democracy be made efficient? Or, in other words, how can production and output be reasonably maintained under democratic conditions?

From the viewpoint of society at large, as consumers, this point is vital. May we perhaps hope in spite of the author's silence on this question that the progress of employee representation will be in fair proportion to union acceptance of some standards of production? Professor Lauck, like Mr. James Myers and others who have written on the development of employee representation, should be followed by some author who would portray for the benefit of both employer and worker alike, the need for and the technique of union standards of output.

JAMES T. YOUNG.

BÜCHNER, RICHARD. *Die Finanzpolitik und das Bundessteuersystem der Vereinigten Staaten von Amerika von 1789 bis 1926*, in *Finanzwissenschaftliche und volkswirtschaftliche Studien*, Vol. 3. Pp. 471. Yena: Gustav Fischer, 1926.

The general scope of this very scholarly treatise on "The Fiscal Policy and the Federal Tax System of the United States from 1789 to 1926," written by a German savant at the University of Breslau, may be indicated by briefly surveying its contents. The work is divided into four main chapters. Chapter one deals with the financial history of the United States from 1789 to the close of the Civil War. Chapter two portrays the political and economic life of the United States since the Civil War, and indicates the effects of their changes upon the tax system and fiscal policies of the Federal government. The third chapter discusses Federal financing of the World War as well as the new tax system, developed since the adoption of the sixteenth amendment, while chapter four treats of the fiscal problems of the post-war period.

These general chapter headings, however, suggest only very remotely the abundance of valuable information, which the author has here accumulated. The work is far more than either the title or the chapter headings indicate. It is in the nature of an economic history of the United States, with special emphasis being placed upon the effects of the political, social, economic, and financial development of our country upon the fiscal policies and tax systems of the Federal, state, and local governments.

The method of treatment is analytical rather than critical; objective, rather than subjective. In the analysis of World War financial problems of the United States, as well as in the discussion of post-war interally debt problems, the author preserves scientific objectivity throughout and reveals no traces of partisanship. The causal relationship of data is carefully observed, and at times materials are introduced into the analysis, which to the casual observer would appear extraneous to the general subject of public finance. For example, the discussion of political parties in the United States, party organization, direct primaries, "spoils system," initiative, referendum, and recall (pp. 69–76), as well as of trust and labor legislation (pp. 120–129), appear somewhat irrelevant to a history of the Federal tax system. But the author very ingeniously links them up with his main topic by indicating how the changes in political organization and in the popular attitude toward governmental functions during the past century and a half have affected public finance and taxation in the United States.

Occasionally, in the development of his logical, causal sequence of events, it is difficult to associate the period in history with the materials analyzed by the author. In other words, the temporal sequence is not always as clearly set forth as is the causal sequence.

The author makes liberal acknowledgment of his frequent use of works in the field of public finance by recognized authorities. The twenty-three pages of selected bibliography in the appendix (pp. 416–439) furnish ample evidence of the abundance of data consulted by the author. This history of public finance should be translated into English, to make it more readily available to those students of public finance in America who are not conversant with German.

KARL SCHOLZ.

GRIFFITH, ERNEST S. *The Modern Development of City Government in the United Kingdom and the United States.* 2 vols. Pp. 745. Price, $14.00. New York: American Branch, Oxford University Press.

A real contribution to the literature of municipal government has been made by Ernest Griffith in his comparative study of British and American cities. The subject is treated comprehensively and with a breadth of vision all too rare among specialists. Mr. Griffith is an Englishman, and he knows his England; but he has studied in the United States, and he also knows America. It cannot be denied that a few of his statements concerning American conditions—his observations on home rule, for example—are the result of a hasty examination of insufficient evidence. It is true, also, that some more recent developments, such as direct legislation, receive very inadequate treatment. But the study as a whole is so well balanced, so scholarly and so sane that a few minor errors of emphasis or of fact may well be forgiven.

Volume I is historical, tracing the development of city government in both countries from the eighteenth century to the present time. The second volume is analytical, the material being gathered under the following chapter headings: "The Legal Basis of City Government," "The Functions of City Government," "The Framework of City Government," "The Finances of the City," "The Relations of Central and City Governments," "The Systems of City Government."

The author who sets out to make a comparative study in which his own country is involved seldom escapes one of two errors. Either he assumes that his country is superior in all things, and must be defended at any cost, or else he proceeds in Mencken-esque style to damn it whole-heartedly. Mr. Griffith does neither. His thesis is found in the statement: "The lesson of America to Britain is equality of opportunity; of Britain to America, the spirit of public service."

Only two principal conclusions are set forth in the two volumes. One is that the American system of taxing the capital value of land is distinctly superior to the English plan of taxing rental value. This point is argued at length and with considerable force. The other conclusion is that cities should be given a considerably greater measure of freedom from central control.

AUSTIN F. MACDONALD.

BRUERE, MARTHA BENSLEY. *Does Prohibition Work?* With a foreword by Lillian D. Wold. Pp. vii, 329. Price, $1.50. New York: Harper & Brothers.

In this carefully edited volume we have the results of a country-wide study of this highly controversial question by a committee of the National Federation of Settlements of which Miss Wold was chairman. It is a book of the first-hand impressions of those engaged in actual local social service. It is not propaganda. It is not intended to be a scientific or statistical book, but in the words of Mrs. Bruere it "is as true as we can make it." The Prohibitionist will find a lot to confirm his views; the anti-Prohibitionist likewise. While the book was not written with a thesis, the Committee in a Chapter "What Was Found Out" makes some highly valuable comments and states many suggestive conclusions, which will be of great help both to social workers and the general student or reader. Both the questionnaire on the answers to which the book is largely based, and a list of those to whom it was sent, are included. Practically every statement of experience is backed up by the name of the person making it. So we have a book that may to that extent be regarded as authoritative.

C. R. WOODRUFF.

STACKPOLE, E. J. *Behind the Scenes with a Newspaper Man.* Pp. 326. Price, $5.00. Philadelphia: J. B. Lippincott Co.

This is one of those volumes of reminiscences which make good reading for the passing hour and constitute helpful sidelights for the future historians. Mr. Stackpole has been a successful newspaper man at the capital of Pennsylvania during a period of forty-four years, during which time he has had the privilege of knowing the leading public men of Pennsylvania, many of them intimately, and herein has put down his recollections and conversations with them. It is not a book of the first importance by

any means, but it makes good reading and gives many an interesting first-hand impression of those whose fame was state-wide and in many instances country-wide. Not the least interesting chapters are those dealing with the leadership of Quay and Penrose, both of whom are treated appreciatively but on the whole discriminatingly. The author is what is known as an "organization man," but first of all he is a newspaper man and his book reflects this throughout. There is little that is captious or critical.

C. R. WOODRUFF.

COMMONS, JOHN R., and ANDREWS, JOHN B. *Principles of Labor Legislation.* Revised and enlarged edition. Pp. xvi, 616. Price, $3.00. New York: Harper and Bros., 1927.

A new edition of this standard manual, following the second edition published in 1920, will be welcomed by all students of labor legislation. Like the earlier editions, it begins with chapters on *The Basis of Labor Law* and *Individual Bargaining*, which analyze the legal principles underlying and controlling labor relations and labor legislation in the United States. *Collective Bargaining*, including not only the law in regard to combinations of labor but also plans of mediation, conciliation, and arbitration initiated by government, is then considered. Protective labor and social insurance laws, the chief topics of the book, are discussed in five chapters: *The Minimum Wage; Hours of Labor; Unemployment; Safety and Health;* and *Social Insurance.* The final chapter deals appropriately with *Administration*, legislation being of little value without efficient enforcement.

It is reassuring to learn from these veteran students of labor legislation that "during the last six years . . . the trend has been consistently forward." They base this conclusion on the progress made in the field of compensation legislation, thirteen states now having included occupational diseases along with industrial accidents in their systems and many more having advanced their standards. Also on the increased attention given to accident prevention, four states having made rock-dusting obligatory in coal mines, on the application of the quota system to the more effective regulation of immigration, on the introduction of the federal-state system of coöperation for the vocational rehabilitation of industrial cripples (1920), and for the provision of medical and nursing care for needy young mothers (1921), and on the enactment by five states and Alaska of old age pension laws. To their minds these progressive measures indicate the "trend." The reactionary developments, particularly the decisions of the U. S. Supreme Court (1923 and 1925) that compulsory minimum wage laws applying to adult women are unconstitutional, and the failure of more than five or six states to ratify the child labor amendment initiated by Congress in 1924 are also duly recorded but regarded as exceptional developments checking only slightly the general forward movement.

As the title indicates, the book is concerned more with principles than with the detailed provisions of labor laws. Readers are recommended to supplement the information given in the text by reference to the *Annual Review of Labor Legislation* regularly published by the American Association for Labor Legislation, of which Dr. Andrews is editor. No one who follows this recommendation can fail to be impressed by the ever-widening scope of labor legislation in the United States, even in a period when the post-war reaction against governmental interference with individual liberty is still an important influence. Even since this volume went to press further evidence of this has not been lacking. Congress has recently enacted a federal compensation law for harbor workers who have been held not to be under the protection of the state laws, and the legislature of New York has passed an eight-hour law for women.

The authors have been assisted in their work of revision by students specializing on particular branches of labor legislation with the result that the book gives as comprehensive and accurate a survey of the network of labor laws in operation in the United States in 1926 as did the first edition for the period preceding our entry into the World War. Like the earlier edition, the present volume has a wealth of footnote

references to the special literature on each topic considered, an up-to-date, critical bibliography, and a complete table of the cases cited, which make it highly serviceable to specialists. By relegating this material to footnotes and appendices, the authors have at the same time achieved their purpose of keeping the text interesting and comprehensible to the general reader. The book is to be commended as an admirable example of what such a manual should be.

HENRY R. SEAGER.

SHAW, KINN WEI. *Democracy and Finance in China.* Pp. 215. Price, $3.50. New York: Columbia University Press, 1926.

Students of Chinese affairs will welcome this clear account of China's fiscal system. Considerable light is shed upon the origin and nature of certain features of this system which have attained international significance, such as likin, salt taxes, import and export duties, and loans, which may not be readily available elsewhere. Some of the writings of influential philosophers are reviewed, revealing the origin and development of the doctrines that the best government is the least government, and that reducing government functions to a minimum would lighten the burden of taxation (Lao Tzu, Chou dynasty, 770—249 B. C.); that economy could best be effected by eliminating the expenses for war or the preparation for war (Mo Ti, born 468 or 459 B. C.); that indirect taxation should be imposed through government monopoly of certain necessities of daily consumption (Kuan Tzu, seventh century, B. C.); that the public ownership of land was a hindrance to the maximum development of the country's agricultural facilities (Shang Yang, 360—338 B. C.); and that certain principles of fiscal justice in revenue and expenditure should be observed (Confucian school).

Part III deals with fiscal reform and the future of Chinese democracy. The author advocates the limitation of consumption taxes to a few commodities, so chosen that necessary or healthful consumption will be lightly taxed or entirely exempt; the abolition of export and internal transit duties; the introduction of a new system of taxation only after a careful consideration of its social effects; local autonomy in working out programs for local tax reform; prevention of double or multiple taxation; honesty, economy and efficiency in fiscal administration; removal of popular misconceptions regarding taxation, such as payment to avoid extortion by officials, preference for indirect taxes, and belief that the minimum taxation is the best taxation; taxation with representation; publicity of accounts with strict enforcement of administrative responsibility; efficient budget-making and effective control of the budget; wise economy; the operation of government industries according to the principle of maximum revenue or maximum welfare; and expenditure of public funds for constructive social development or for social amelioration.

Taking into consideration present-day conditions in China, a program for social reconstruction should include: increased facilities for education; adequate highways; national railways; development of shipbuilding and commerce; settlement of open regions; reclamation and irrigation; mining development under government supervision; forest conservation; protective labor legislation; public health measures; improved consular service; stabilization of coinage and currency; improved banking facilities; and experimentation in agriculture.

Conveniently appended are tables of Chinese chronology and of currency, weights and measures and a usable bibliography. This volume constitutes another valuable contribution to the growing list of authoritative and readable works on the Far East, in response to increasing recognition of the probability of the future advent of China into the family of Great Powers.

W. LEON GODSHALL.

CLAPP, EARLE H. *A National Program of Forest Research.* Pp. ix, 232. Washington: Published by American Tree Association for the Society of American Foresters, 1926.

For the first time, an attempt has been made to show a connected picture of the whole field of research in forest production and utilization. North American Forest Research, published in 1920 as a bulletin of the National Research Council, merely

listed the projects under way at that time. This volume goes much farther. Its purpose is to stimulate and correlate forest research in the United States. In the words of the author, "we have now reached the stage where the situation calls unmistakably for the development of forest research as a big national undertaking."

The renewal and perpetuation of our timber supply, the efficient utilization of wood and other forest products, and the effective utilization of a quarter of our entire land area present an almost infinite variety of problems. After sketching in a general way the need for research in forestry, the report undertakes to outline these problems systematically and in considerable detail. Although the field is bewildering in its complexity and in the intricate interrelationship of its various phases, the whole survey keeps clearly in sight the underlying objectives of maximum efficiency in land use and in supplying the American people with needed forest products.

The work already done or under way is described, with an account of the various agencies now engaged. In presenting a comprehensive program for the future, it is emphasized that the most effective results can be obtained only through coördination of the efforts of all workers. Two outstanding recommendations are made. The first is for an organic act which will gather into one comprehensive law the more or less scattered legislative authorizations under which the United States Department of Agriculture now conducts forest research. In order to insure continuity of effort, the proposed act would authorize appropriations sufficient for the next ten years. The second recommendation is for an amply endowed Forest Research Institution, whose main function would be the prosecution of long term fundamental studies which no other organization is in a position to undertake.

This program is not only for foresters, who, after all, can hope to cover but a small portion of the field. As much as in agriculture, perhaps even more, research in many branches of science is involved. Particularly is it hoped that workers in many of the biological, physical, and economic sciences will be stimulated to direct their attention to the problems of our forests and forest industries.

W. N. SPARHAWK.

CHAMBERLAIN, LAWRENCE, AND EDWARDS, GEORGE W. *The Principles of Bond Investment.* Revised edition. Pp. xii, 699. Price, $7.50. New York: Henry Holt and Co., 1927.

DEWING, ARTHUR S. *Financial Policy of Corporations.* Revised edition. Pp. xix, 1281. Price, $10.00. New York: Ronald Press Co., 1927.

These two books afford a liberal education in investment and corporation finance. If a person could read only two books in the field, unquestionably these should be the two.

Fifteen years ago Lawrence Chamberlain wrote what was then, and in many ways still remains, an epochal book, a bible for the bond men. It was a profound and mature discussion of bonds from the investor's standpoint, charmingly written. Much water has gone over the dam since then: the Great War, a reorganized banking system, a great expansion of taxation, much study of business cycles. A new edition was called for. With the collaboration of Dean Edwards it has appeared. The old skeleton with much of the flesh still remains; but new blood has been injected and we have an up-to-date product.

Part I, "Channels of Investment," analyzes the elements of an ideal investment, defines investment as a loan (thereby excluding stocks and real estate) and gives an excellent classification of bonds. Part II discusses "Civil Loans," arriving at the somewhat sweeping conclusion that "American municipal bonds are the best security for the American people to buy" (p. 264). Part III, "Corporation Loans," offers a succinct statement of the leading types of corporate bonds, including real estate bonds. Part IV, "The Mathematics and Movement of Bond Prices," contains somewhat technical material, the value of which to the ordinary investor may be questioned. He will depend on his bond house for such matters as computing the yield of a given security at a given price. Part V, "Investment Organization," treats the classes of investors and the work of bond houses. Part

VI deals with the difficult and ever-changing problem of "Taxation of Bonds."

One has the feeling that the book is addressed mainly to the conservative, well-to-do investor who buys thousand dollar bonds at a clip. Little attention is given to the humble saver, although some tell us that in America the masses are becoming capitalists. Must the masses be content with a savings bank account and 3 or 4 per cent interest, as suggested by the authors (p. 34)? Why not Building and Loan shares yielding 6 per cent or more with a splendid record of safety (a form of investment not even mentioned in the book, although six billions of American savings are so invested)? Considering the savings placed in life insurance, in home ownership, and in Building and Loan Associations, is it not somewhat arbitrary and misleading to assert the perfect investment as "a promise to pay; it is always a loan" (p. 15)? Incidentally, if one has in mind primarily the middle-class investor should he not add to Chamberlain's ten cardinal tests of an ideal investment another, namely *incentive to systematic saving*? Most of us do our saving with the least conscious sacrifice when we do it systematically; in other words, when it becomes a habit. Some investments are admirably adapted to systematic saving, for example monthly payments on a home, on an insurance policy, or on a bond. Some are not adapted to systematic saving, for example the savings bank account or the outright purchase of a bond.

While the book leaves much to be desired as a treatise on investment, it covers the field marked out for itself—bond investment—better than any other work in America.

Professor Dewing, in revising his important work published in 1920, has added among other topics a group of chapters entitled "Investments." To him investment has an altogether different meaning than it has to Chamberlain and Edwards. Dewing discusses investment policy solely in terms of stocks and bonds, and has much good to say of common stocks as investments. Dewing's rule is to buy bonds at the top of the industrial cycle and sell them at the bottom; buy stocks at the bottom of the cycle and sell them at the top. Much statistical testing of the different classes of bonds and stocks has been going on at Harvard and Dewing's conclusions are based largely thereon. In view of Chamberlain's strong recommendation of municipal bonds as the best security to buy, Dewing's statement is interesting, "It is obvious that tax-exempt securities are, as a class, a poorer investment than taxable securities" (p.1196).

But the chief merit of Dewing's work lies in the other parts of his book, the parts dealing with the financial policy of corporations. A truly remarkable amount of research has entered into the project; what various corporations have done under various circumstances. The work, therefore, is empirical, a series of generalizations based on synthesized data. The promotion of new enterprises is discussed, with a workable financial plan for a manufacturing enterprise, a public utility, and a railroad. The proper administration of income in a going concern is analyzed, and the when and how of expansion of successful businesses are treated. The discussion of the failure and reorganization of bankrupt corporations reflects the thorough study made of this subject by Dewing in earlier years. The author seems to feel optimistic over the results of such recent tendencies as customer ownership of public utilities and the issue of no-par shares. However, he avoids discussion of the grave issue raised by his colleague, Professor Ripley, regarding the separation of ownership and control. Surely this policy of corporations, if the practice of divorcing ownership from control may be said to have become a policy, deserves more discussion. Dewing should be able to make a contribution to that discussion.

On the whole Dewing's book remains the outstanding work in the field, a fine example of scholarship applied to practical affairs.

ALBERT S. KEISTER.

VERRILL, A. HYATT. *The American Indian.* Pp. xxvi, 485. New York: D. Appleton and Company, 1927.

It would be unfair to review Mr. Verrill's work as one would a scientific study, for it does not pretend to be one. It was not written for the anthropologist, but for the layman, and consequently covers a wide

field with a minimum of scientific terminology and statistical data and no page index, bibliography or footnotes whatever. The origin, characteristics and culture of the American Indian in general are discussed in the first half of the book, while the last part is devoted more specifically to various culture areas of North, Central and South America, with a dangling last chapter on "Indian Wars and Warriors." "In particular, the author has endeavored to point out how much we owe the so-called Redman and how outrageously he has been treated; to correct many false ideas and to destroy many misconceptions regarding the Indians in America."

Criticized as a semi-popular educational effort, there is much to be said for *The American Indian*. It presents a more accurate composite picture of its subject than is usually obtained by the average man. The diversity of physical and mental types found among the Indians is wisely emphasized, as is the diversity and complexity of cultures. An attempt is made to correct the common impression of the native American as a "savage." Without question the ordinary reader should lay down this book with a higher and more accurate estimate of the character and achievement of the early inhabitants of the Americas.

Mr. Verrill falls short of his announced goal for several reasons. His theories, not always resting on too firm grounds, are likely to confuse and mislead the uninitiated. This is particularly true of his chapter on "Who are the Indians." A quotation may in part illustrate the point:

> *"After all, why should we attempt to account for the American Indian by theories of his ancestors' migrating from the Old World? If man evolved from some lower form, or was created, in Asia, Europe, or Africa, if he has always been indigenous to any or all of those countries, why should he not have originated in America as well? Is there any valid reason to assume that, if man originated or developed under certain conditions and favorable environment in the Old World, he might not have done the same in the New World under similar conditions?"* (p. 6–7).

There is also a confusion of multitudes of facts, frequently inadequately explained for the untrained mind, which makes it unlikely that the work will be carefully read or understood by many of those for whom it appears to be intended. The presentation holds the reader's interest at first, but becomes tedious long before the end is reached. This is a more serious defect than it would be in a technical publication, a defect which may render sterile Mr. Verrill's laudable efforts.

Clark Wissler's recent edition of his *The American Indian*, though written with a far different purpose than the book under review, has made an immediate attempt to cover approximately the same field unnecessary. It may be sincerely regretted that Mr. Verrill has not devoted his time and distinct talents as a popular writer to the publication of his experiences and discoveries among the archeological remains and Indians of Central and South America.

DONALD YOUNG.

CALHOUN, ARTHUR W., PH.D. *The Worker Looks at Government*. Pp. 176. Price, $1.60. New York: International Publishers, 1927.

The author holds that there is no great need for more than one party in the United States at present, that any measure threatening the capitalist system would be killed promptly without regard to party lines, and that the major function of government is to provide a general directorate for the capitalist system (p. 91). He holds further that, from the labor viewpoint, little is to be gained from tinkering with the forms and processes of government, and from a change in personnel; that real headway can be made only by a reconstruction of the economic system on a human basis (p. 19), since the propertied interests, so long as they exist, can dominate through their economic power over voters, through the aid of the various avenues of publicity, and by the hypnotic spell of capitalist prestige. During the period of reconstruction and transition, the proletarian dictatorship would be a temporary makeshift. Next would come an era of democracy, in which the workers would not be overawed by a dominating class, and in which each legislator would be a messenger from his constituents and the erstwhile ex-

ecutives reduced to a purely administrative rôle.

Objection is made by the author to the application of the term "socialization" to the progressive income tax program, "so long as the state is responsible to the dominant capitalist system" (p. 137); nor does public ownership of public utilities represent socialization, since it "does not assail the principle of private property, neither does it make any notable concessions to Labor" (p. 147). The LaFollette campaign of 1924 is termed a "fiasco," and President Green is chided for deprecating class politics (p.167). Berger and the British Labor Party receive faint praise.

Broadly speaking, the author sees two types of exponents of the present capitalist régime: (1) Those who favor central regulation and unification, welfare work, progressive taxes, and a certain degree of public ownership; it is their endeavor to keep capitalism workable, holding that "the claims of the property system as a whole take precedence over the claims of particular property interests" (p.136). (2) Those with short vision who "resent the enforcement of what is bound to prove a necessary step in the development of capitalist industry" (p. 96). These latter are twitted for their lack of class-consciousness, their inability to see that expenditures for high schools would be good investments (p.135), and their narrow opposition to all government enterprise. "They . . . can as a rule be depended on to act as a drag on the perfecting of the capitalist system itself" (p. 150).

Although the reviewer is thoroughly opposed to all of the major tenets of this treatise, he feels constrained to warn that no fair appraisal of it can be made from a hasty reading. Nor can a short review do it justice; nearly every page sets forth a thought worthy of a reviewer's attention. Many readers will find a highly instructive analysis in the two chapters on "The Judicial Power" and "The Problem of the Supreme Court." Of equal interest are the discussions on the stand which Labor should take on current issues. Every one of the sixteen chapters has the earmarks of painstaking preparation.

W. E. BUTT.

MILLS, CHARLES M. *Vacations for Industrial Workers.* Pp. viii, 328. Price, $5.00. New York: The Ronald Press, 1927.

This volume is peculiarly adapted to the needs of the industrial organizer, or economist who is primarily interested in the labor factor of production. It marks the start of a series of research volumes based on humane relationships in industry. The book is based upon information gathered from twenty-nine countries of the world, including not only the United States, but among others, France, Switzerland, Belgium, Italy, Austria, Czechoslovakia, Germany, the Netherlands and Great Britain.

The first part of the book deals with the problem of vacations in general. This is followed by a survey of the situation in the United States, and part three includes an extensive study of the other nations under observation. The book concludes with about ninety pages comparing the vacation movement in the countries investigated. An excellent bibliography is included.

Mr. Mills reaches several conclusions as a result of his study. He states first that the granting of vacations to industrial workers has three effects: (1) it increases the man's respect for himself; (2) his health is improved; (3) it raises the problem of leisure time. He further points out that several (thirteen) leading European nations have "vacation legislation" which is totally lacking in the United States. It is impossible to analyze here the vacation plans of all these countries, but it is notable to point out a peculiar feature in those plans of Soviet Russia:—thereby a worker may, with government permission, have extra pay instead of the required vacation.

The systems of 199 companies in the United States were studied and classified under three plans: the graded, ungraded, and shut-down plans. For the most part, vacations have been for one or two weeks, according to length of service. It is interesting to note that Mr. Mills is dealing only with vacations with pay—as he defines the word.

The study has been an intensive one and deserves great praise. It is recommended to any employer or efficiency expert who desires, as Mr. Mills words it, "to increase efficiency and make greater profits."

The company adopting a vacation on this basis does not do so because "it is a good thing to do for the men," or because "it promotes health," or is "socially just," or a "reward," but because it tends to increase efficiency and make greater profits. Such a company believes that against the added cost of salaries and wages can be placed increased morale, loyalty, and renewed energy.

ALICE WESCOTT.

JEROME, HARRY. *Migration and Business Cycles.* 256 pages. St. Albans, Vt.: The Messenger Press.

This volume presents the results of the investigations made by the National Bureau of Economic Research at the request of the committee of the National Research Council.

Doctor Jerome throughout the book analyzes the records of migration to and from the United States and compares those records with various indices of business activity here and abroad. He answers two queries:

(1) To what extent are fluctuations in migration attributable to fluctuations in employment?

(2) To what extent, in turn, are fluctuations in migration an ameliorating influence, and to what extent an aggravating factor, in employment and unemployment fluctuations?

The book is authoritative and is well done. There are no outstanding conclusions. The facts show both strong cyclical and seasonal movements in immigration and emigration and abundant evidence that when immigration is not restricted the character of the cyclical variations, at least, is closely similar to the cyclical variations in employment opportunity in the United States. A fairly close similarity is also found in the seasonal movements. The seasonal peak in immigration is in the spring, well-timed for the summer increase in those outdoor activities in which many new immigrants ordinarily find employment; and the maximum emigration is reached in the late fall and early winter when jobs are becoming relatively scarce. Similarly, a period of depression in the United States is ordinarily accompanied or closely followed by a decline in immigration and an increase in emigration; and a period of prosperity, by an increase in immigration and a decline in emigration.

CLYDE L. KING.

THORP, WILLARD LONG. *Business Annals.* Pp. 380. New York: National Bureau of Economic Research, Inc., 1926.

This volume, edited by Willard Long Thorp of the staff of the National Bureau of Economic Research with an introductory chapter by Wesley C. Mitchell, Director of Research, and a foreword by Edwin F. Gay, Director of Research, covers United States, England, France, Germany, Austria, Russia, Sweden, Netherlands, Italy, Argentina, Brazil, Canada, South Africa, Australia, India, Japan, and China.

It traces the fluctuations in economic and social fortunes in seventeen countries throughout a range of from 36 to 136 years. The volume traces the fluctuations in manufacturing, construction work, employment, domestic and foreign trade, prices, speculation, financial operations, and agriculture, so far as the facts can be gathered from available sources. British and American annals go back to 1790; the French to 1840; German to 1853; and Austrian to 1867. One of the most valuable sections of the book is the bibliography of twenty pages.

CLYDE L. KING.

LEVEN, MAURICE. *Income in the Various States.* Pp. 306. New York: National Bureau of Economic Research, Inc., 1925.

This volume is a continuation of the splendid research work started by Wilford I. King. In the minds of most students the National Bureau of Economic Research has made its most distinctive contribution in the field of income studies. This work, as the others, is authoritative. Together they constitute the best studies on income made in the United States. It is a statistic study well done and worthy of place in the libraries of all students of the social sciences.

CLYDE L. KING.

BECK, JAMES M. *The Vanishing Rights of the States.* Pp. 126. New York: George H. Doran Company, 1926.

This is a brief by counsel for the seating of Messrs. Smith and Vare. The lawyer takes his privilege of omitting many of the essential factors in that contest. For instance, he pays no attention to ballot box stuffing and vote stealing and, therefore, he does not try to answer the fundamental question as to whether or not the Senate of the United States can maintain its dignity as a representative body while admitting to its membership those whose position was secured by bribery and corruption.

CLYDE L. KING.

Index